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ARCHITECTURE.—MARBLE STATUE BY MONTEVERDE, AT THE PARIS EXHIBITION.

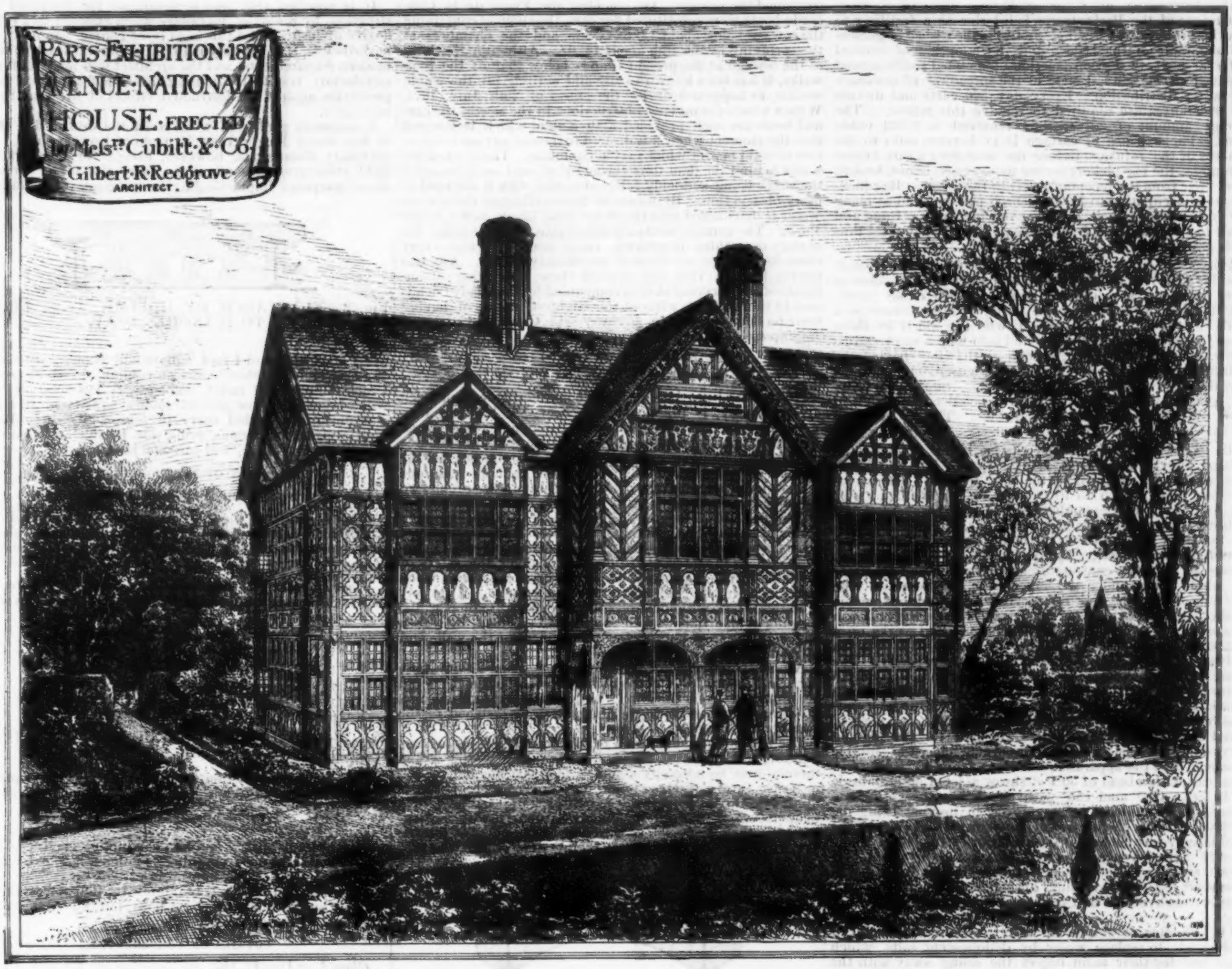
PARIS EXHIBITION.—ENTRANCE TO THE FINE ARTS GALLERY, CHAMP DE MARS.

ARCHITECTURE AT THE PARIS EXHIBITION.

The marble statue of Architecture by Julius Monteverde is destined to ornament the tomb of Carlo Sada, of Turin, the architect of the palace of the King of Italy. The downcast eyes of the figure are suitable to the place for which it is destined, the Campo Santo, and the attitude expresses that serenity and repose which belong to Architecture. No art has had greater honor in the present Exhibition than has architecture, and rightly so, for the works of none can be enjoyed with less fatigue. The gardens of the Champ de Mars and Trocadéro are crowded with houses of all styles, of all epochs, and of all nations. The handsome pavilion of the Bey of Tunis is but one example out of many, and in addition to edifices of this kind the Fine Arts Gallery of the Champ de Mars contains a long succession of architectural drawings and models.

THE FINE ARTS GALLERY AT THE PARIS EXHIBITION.

The northern vestibule of the Fine Arts Gallery, situated in the Champ de Mars buildings at the meeting point of the French and Foreign sections of the International Exhibition, is the subject of our present illustration. Its façade is composed of three vast arches, upheld by great square pillars, and forming a triple portico, which has a grand aspect; while the architectural lines are agreeably softened by the mild yellowish-white tint of the structure in general. There is a spacious forecourt, beyond which is the entrance to the Fine Arts Gallery, betokened over the doorway by the model of a Greek temple, with a hemicycle of a colonnade extended in rear of it, and to right and left; all of gray material, but suffused with a delicate rosy tinge. The side entrances, leading respectively to the French and to the Foreign Section, are decorated with colored landscape designs, upon a surface of porcelain or earthenware tiles, below which are represented, by colossal female figures, the Arts of Sculpture, Architecture, Painting, Engraving, Pottery, and Metallurgy, each with her proper tools.—*Illustrated London News.*



ENGLISH HALF TIMBERED HOUSE AT THE PARIS EXHIBITION.

ENGLISH HALF-TIMBERED HOUSE AT THE PARIS EXHIBITION.

This building forms the fourth house of the English façade in the Rue Internationale, at the Paris Exhibition. It has been erected by Messrs. Wm. Cubitt & Co., of Gray's-inn-road, from the design of Mr. Gilbert R. Redgrave, the architect of the Royal Commission. The timber employed is pitch-pine, and the panels have been filled with cement concrete faced with Parian cement. The arms in the gables are those of the four counties of England where this kind of work was principally employed in the fifteenth and sixteenth centuries, viz., Cheshire, Warwickshire, Worcestershire, and Staffordshire.—*Building News.*

ANTHRACITE COAL IN FRANCE.

The introduction of this great staple of commerce is an incident of the Exhibition, and if successful will soon compensate the United States for all expenses incurred in sending goods to Paris. Mr. Edward A. Quintard, who represents the Reading Railroad Company, in bringing over a 40-ton railway engine for the Exhibition, freighted a vessel with anthracite coal, which is being purchased in Havre at good prices by the French iron manufacturers for experiment in their furnaces. Of the result of the experiment there can be no doubt; the superiority of anthracite in blast furnaces is well known in America, and it has only to be known in Europe to create an unlimited demand for an inexhaustible American product.—*American Advertiser, Paris.*

STREET CLEANING OF PARIS.*

The street cleaning of Paris was placed under the management of the City Engineer by a decree of October 10th, 1859. This paper will treat—

1st. *Personnel.*

2d. Material and Disinfectants.

3d. Sweeping Public Ways, Halls and Markets.

4th. Removal of Mud and all Refuse.

5th. Street Sprinkling.

1st. *Personnel.*—There are two Chief Engineers, each at the head of a division; 8 Engineers aided by 51 Assistant Engineers, and 61 Subassistant Engineers—in all 112 agents. The work is supervised by the General Inspector of bridges and roads, who is the head of the Department of Public Works of Paris, and the whole *personnel* costs, exclusive of Engineers' salaries, 260,000 francs, or about $52,000, per annum.

2d. *Material and Disinfectants.*—These are kept for the First Division in a central store, and all implements and compounds are classified and delivered against receipt to the division engineers, who are responsible for them. In the Second Division there is a similar store for each section. The disinfectants are chloride of lime, sulphate of zinc, sulphate of iron and carbolic acid—muriatic acid and nitrobenzole are used for cleansing.

For decomposing the volatile compounds of organic fermentation, the chloride of lime proves an excellent disinfectant, being specially efficient for fecal or putrid matter. For gutters it is used in twenty times its own weight of water.

Sulphate of iron and sulphate of zinc are both used for the same purpose and are combined with ten times their weight of water. The sulphate of zinc is more energetic in action, costs more, but is odorless and is much used in summer to disinfect the cellars under the fish and poultry markets. Diluted in 8 volumes of water, with 3 per cent. of sulphate of copper added, it will keep long and is an excellent disinfectant for dwellings. Carbolic acid is not, properly speaking, a disinfectant. It will not dispel bad odors, but prevents putrefaction. It is a powerful antiseptic, and its proper combination is 40 volumes of water to one of phenol or carbolic acid. Foul places, such as slaughter houses and markets, are sprinkled twice a week in summer with a solution of one volume of acid in one or two hundred volumes of water. Stagnant pools are sprinkled with water containing a thousandth part of carbolic acid. Hydrochloric acid is used for urinals and water-closets, in a solution of six volumes of water.

Nitro-benzole is energetic in action, but leaves a strong smell and a whitish crust which must be removed by water. Its mixture is the same as hydrochloric acid. The two latter disinfectants oxidize metals and burn clothing. Only the most careful workmen are allowed to use these acids, and they are comparatively innocuous when diluted in ten parts of water. The annual expenditures for this branch of the work is 220,000 francs, or $45,000.

3d. *Sweeping of Public Ways.*—The principal enactions of the latest law concerning street cleaning (which took effect January 1st, 1874) are:

First.—The obligation previously incumbent on land tenants on all streets and thoroughfares to sweep half of said ways in front of their premises is converted into taxation payable in money.

Second.—But the payment of said tax does not exempt land tenants from any obligation which may be imposed on them by police regulations in time of ice or snow. This taxation is proportioned to rates of travel and health necessities of location.

The street area cleaned in Paris, under supervision of the City Engineers, is 3,581 acres, of which 2,000 acres are for account of land tenants, and 1,000 acres for city's account. But as metaled roads and their sidewalks are cleaned by a special body of men, the cleaning proper of the streets of Paris includes an area of 2,667 acres. The whole of this surface is swept once every morning between 3 and 6 in summer, and between 4 and 7 in winter, after which come the scavengers, who run in summer from 6 to 8 and in winter from 7 to 9 o'clock.

In addition to this the streets are swept when needful; street gutters cleaned twice daily; public seats and urinals washed; streets cleaned and disinfected, and police stations taken care of. This work is not usually complete till late evening, especially during severe frosts, when sand has to be sprinkled over streets having steep inclines.

The city employs 3,000 persons—2,200 men who earn from 50 to 80 cents a day; 950 women earning from 4 to 5 cents an hour, and 30 young boys at 4 cents an hour. These compose 122 gangs, each made up of one foreman and 30 workmen in 1st division and 16 working people in the 2d division. Besides this small army of workers, 190 sweeping machines are required for street cleaning; since one machine does the work of 10 men, they are equivalent to 1,900 men, making in all the equivalent of 4,900 people employed.

The Halles Centrales require incessant attention from the street-cleaning departments. They are built in the center of Paris, and consist of ten lofty cast iron *pavillons*, set on stone basements. The *pavillons* are connected by covered alleys. Each *pavillon* is used for retail trade. The cellars are store-rooms for implements used in handling provisions. The work done at the Halles consists of sweeping, washing, removing refuse and disinfecting. Sixty persons are thus employed in these Halles. The morning sweeping is done, 1st, with a wooden scraper; 2d, with a birch broom, and lastly with a machine. In washing these markets, ordinary water is first used, then solutions of carbolic acid. All wetted parts are lastly cleaned and dried with an India-rubber scraper. The refuse is removed several times daily. That taken from the cellars sometimes amounts to 2,471 cubic feet daily. It consists of manure, vegetable remains and offal, which are hoisted by swinging cranes into the carts. For this, small cars with movable bottoms are employed; they contain one cubic yard each, and are brought under a hole where they are seized by the crane, then hoisted and their contents dropped into the cart by an opening in the bottom.

Sweeping Machines.—Two are used, the English machine perfected by Sohy, of Paris, and the machine patented by M. Blot. Sohy's is considered the best. In both, the machinery is simple and reliable. Each occupies little space, consisting only of a strong frame carried on two wheels, with a driver's seat, and drawn by a single horse. On the rear is the sweeping apparatus, made of an inclined cylinder with spirals of piasava splints. This brush is set in motion by a wheel to which it is connected by a gearing which the driver can connect or disconnect, at will, from his seat. The machine is used in all weathers and is efficient on all roads and pavements, whether metaled or asphalt. The mud and dust gathered is left in long strings, which, at the return of the machine, are thrown nearer the sidewalk and so on, until it can be put in piles nearer the gutter, or thrown into the sewers. One machine weighs 1,650 lbs., requires only one horse, who works at walking pace and sweeps 1½ acre hourly. Either machine when new costs $200 and requires $40 a year for repairs, outside renewal of brush roller, which costs $14 per brush, which is serviceable for 160 to 180 hours.

The annual total for cleaning the streets of Paris is $584,000.

* A paper read before the Civil Engineers' Club of the Northwest, June 18th, 1878, being a translation from the French of M. Vaissiere, Chief Engineer of Bridges and Roads, by L. Soulerin.

4th. *Removal of all kinds of Refuse—Ice and Snow.*—The refuse of the Paris streets is inferior as a fertilizer to what it formerly was, owing, firstly, to the disuse of gutters in the middle of the streets and the adoption of curved surfaces; next, to the construction of metaled roads instead of paved streets, and, lastly, to the spreading of sewerage and water distribution. Every day 520 carts and drivers and 980 horses are required to remove this refuse. The average amount of all matters removed is 2,223 cubic yards. The expense of cartage is in inverse ratio to the richness of the refuse. Before the scavenger's cart begins its rounds, the rag-pickers secure paper, rags, bones, broken glass, etc., from the receptacles left in the street. Rag-picking gives occupation to 7,000 licensed persons, and as many non-licensed ones, their earnings varying from a franc and a half to two and three francs a day. The yearly total thus made amounts to 7 or 8 millions of francs.

Removal of Ice and Snow.—The area from which snow must be removed is 4,220 acres, and a depth of 4 inches of snow represents a volume of over 1,961,000 cubic yards. This accumulation is removed partly by land tenants and partly by the city administration, who are aided by those sewers which convey hot water and into which snow can be thrown without danger. As soon as thawing begins the hydrants are opened, sweeping machines used, and in a short time the city resumes its ordinary aspect. Snow plows cannot be used in Paris, as the snow is not deep enough and is too quickly hardened by pedestrians. The annual total for this branch of work is $181,000.

5th. *Street Sprinkling.*—The city sprinkles not only the planted alleys, the squares, bridges, quays, but also those parts which are watered by the land tenants. The operations last from March 15 to October 15 for metaled roads, and from April to September for the paved ways. Water is thrown daily by means of water tanks, or hose and nozzle, the latter being used on the boulevards and some of the more important streets. Tanks and hose, with their frames, belong to the city—contractors supply horses and drivers—the whole being under the supervision of the city. The best tank used is the tank Sohy. It is an oblong box, made of sheet iron, has a seat for the driver, whence the tank can be worked. The tank contains 340 gallons, and works on a strip 15 feet wide at each passage. It is emptied after a run of from 1,500 to 2,000 feet, according to its capacity. The filling is done by a leather or India rubber hose screwing to hydrants under the sidewalk and so spaced that the tanks have short distances to run when emptied. One tank suffices for an area of 2½ acres of metaled surface, or 5 acres of paved streets. Hand sprinklers are used for the planted alleys—the hose is screwed to hydrants placed at suitable distances, and the apparatus, which is from 40 to 46½ feet long, can with a head of 50 feet throw a jet of an amplitude of 40 feet. One man can with this apparatus sprinkle 5 acres in 35 minutes, time employed in moving being deducted. It is economical and convenient and its use has been largely introduced into the interior of the city. There are 322 tanks in use, which consume a daily average of 1,600,000 galls. The cost of each tank, including driver, is $48 per month. Hose sprinkling, all incidentals being counted, costs a trifle over one half the expense of water tank sprinkling.

This chapter would be imperfect without an account of trials made to replace water by deliquescent salts, which trials had for their main object the doing away with the unsightly water tanks and the inconvenience resulting from an uneven spreading of water. In 1859 and 1863, Mr. Darcy, chief engineer in charge of promenades in Paris, experimented on the principal avenues of the Bois de Boulogne. He first used refined chloride of calcium, which was very expensive; as it could not be dissolved in water so as to be thrown from tanks, it had to be thrown by hand, in quantities of 250 grammes for each square meter; its efficiency was felt for five or six days. Later, in 1862, experiments were resumed with crude salt mixed with chloride of manganese. It was sprinkled by hand, 500 grammes to the square meter, but was only efficient three days, and if the air was not moist a light sprinkling of water was necessary. In 1864, General Inspector Homberg made some new trials. Pure and white chloride of magnesium was the salt used and which could be completely dissolved in water. It was found that the operation had to be performed in the evening, by throwing the salts either dry and by hand or in solution in water so as to spread 500 grammes per square meter for the metaled roads and 400 for the pavements. For the first 24 hours the result is good, but the following day one sprinkling has to be done, two sprinklings are necessary the second day, and the effect has entirely disappeared on the third day. Sprinkling the dissolved salt with the tank costs more than salt thrown by hand. An area of 2½ acres requires 5 tons of salt, lasting only three days, costing 100 francs, and 112 with the labor, against 36 francs, the cost of *ordinary* tank sprinkling for the same area. Hence it results that the use of deliquescent salts would be very onerous. The sprinkling with water adds freshness to the air, prevents dust and opposes dryness, while salts, taking the little moisture left in the atmosphere, would prove far less hygienic if used, and only in case of lack of water is it allowable to use deliquescents in Paris. Street sprinkling costs the city of Paris $90,000 annually. The total expense of the services above recapitulated is $973,000 annually.

SEWERAGE OF PARIS.

There are three main sewers or collectors in Paris. The one hundred thousand closets of Paris do not empty direct into these. Cesspools are provided and are cleaned out periodically by means of a pneumatic apparatus which is said to separate the solid from the liquid and allow only the latter to run into the sewers. Descending a winding staircase in the Boulevard Sebastopol we found ourselves in a spacious gallery of railway tunnel shape, the sewage water passing down a central channel under our feet. The width of the main chamber at the springing of the arch might be estimated at about 16 or 17 feet and the height of the crown at 12 or 13 feet above the footways. This gallery was lit up with lamps and had a most impressive appearance; on each side supported on frames were the two great water mains from Ourcq and likewise telegraph wires from every district. Gas pipes are prohibited on account of the danger from explosions. Having inspected these and talked in broken French to the inhabitants of these parts, we were each provided with a seat on a species of tram car lighted up at each corner with a lamp, run on to a turn-table and shot off at about right angles into a smaller gallery which runs from the Boulevard Sebastopol to the Place de la Concorde. Here the men harnessed themselves to a species of cross tree which enabled them to run along the footwalks while the car ran on rails placed on each side of the central channel which contained the sewage. On reaching the Place de la Concorde boats were substituted for cars, the channel containing the sewage being about 12 feet wide and the chambers at the springing of the arch about 18′ 0″. Although the level of the sewage at the present time is below that of the footwalks, it has been known to rise and entirely fill the whole section, as happened during the storm of 25th July, 1872. With a view of removing obstructions in the sewers the cars and boats are each provided with a dam which is lowered into the channel when it is desired to remove any such collection of solid matter which may accumulate. The level of the water behind the dam thus formed rises, and on its removal the water being suddenly released carries with it the mud or other obstruction. By means of these collectors the sewage water is discharged into the Seine some fifteen miles below Paris. The arrangements are admirable, and excepting the sewage everything is perfectly clean, and even it seems very clean for sewage, as there is no offensive smell. Any one paying Paris a visit may inspect these interesting monuments of engineering skill accompanied by their lady friends should they wish it, without the slightest chance of having their feelings shocked in any way.—C. Graham Smith, *in Engineering News.*

FIRE-PROOF CONSTRUCTION.*

No material used in building construction, except brick or burnt clay, is practically fire-proof. A building constructed of incombustible material throughout, and stored with only small quantities of combustible and inflammable matter, can be considered fire-proof. Warehouses for the storage of miscellaneous merchandise cannot, with our present knowledge, be constructed absolutely fire-proof; we can only apply devices that diminish the danger by confining and localizing the conflagration. Generally public places of amusement, churches, schools, offices, or dwellings do not contain so much inflammable matter, such as furniture, etc., as to materially injure or endanger the safety of the building when properly constructed. Warehouses, when stored with inflammable matter, even if constructed entirely of brick, but without precautionary, subdividing walls, forming compartments, will succumb to the heat, by reason of the great expansion causing a movement of the walls and ultimate collapse of the floor arches.

All constructive ironwork in buildings, except those having small quantities of combustible furniture in them, should be protected from the direct action of a fire by some fire-proof and non-conducting coating, securely fastened to the member it is intended to protect.

The maximum temperature of a vigorous fire, raging in a building fed by combustible and inflammable matter stored therein, may be correctly assumed at 2,000°—equal to that in brick furnaces. It is found that the strength of iron is diminished about 66 per cent. when at a dull red heat, or a temperature of 977°; at this temperature ironwork proportioned to three times safety would be at the point of failure. We will compute, approximately, the time required in raising to 977° the temperature of a cast-iron plate one foot square and one inch thick, representing the side of a square column. The amount of heat required to raise the temperature of the plate to 977° is—the specific heat of cast iron being 0·13 unit and the weight of the plate 40 pounds—977° × 0·13 × 40 = 50,804 units. The conducting power of the plate, under the existing circumstances, is 233 (2,000 — 977) = 238,359 units per hour, and as we have only 50,804 units to conduct, the time will be $\frac{50804}{238359} = 0{\cdot}213$ hour = 13 minutes. If the plate be protected by a layer or coating of ordinary plaster, one inch thick, the amount of heat conducted will be only 3·86 (2,000 — 977) = 3,949 units per hour, or $\frac{50804}{3949} = 13$ hours longer; when protected by 4½ inches of brickwork, only $\frac{483 . (2000 - 977)}{4{\cdot}5} = 1{,}100$ units per hour will be conducted, or $\frac{50804}{1100} = 46$ hours longer.

Fig. 1.—ARCHES OF BRICK.

Weight of construction from 60 to 100 lbs. per square foot; *a*, single rim arches of brick, up to 8 ft. span; rise of arch 1-12 of span; *b*, rolled iron beams; *c*, concrete filling; *d*, strips of wood 2″ × 2″, about 16″ from centers; *e*, flooring nailed to strips *d*; *ce*, filling between strips.

Buildings stored with large quantities of inflammable matter may have cast-iron columns of square cross-section of the necessary dimensions to carry the superimposed weight, with skew-backs cast on, for supporting brick arches between the columns that carry the floors; the column is enveloped by 4½ inches of brickwork as a protecting layer only. This method, admits a considerable reduction of the size of piers from those built of brick only; for example: The height of a pier is 18 feet, and the weight to be carried 100 tons; a, cast-iron column 10 inches square, with thickness of metal 1 inch, will carry the weight with eight times safety; 4½ inches of brickwork will increase the size of pier to 19 inches. A solid brick pier, allowing 70 pounds per square inch as its safe resistance to crushing, will carry only $\frac{19^2 \times 70}{2000} = 12{\cdot}7$ tons. To support a weight of 100 tons, the pier would have to be $\sqrt{\frac{100 \times 2000}{70 \times 144}} = \sqrt{19{\cdot}91} = 4' 6''$ square.

Fig. 1′.

The arches may be supported on angle irons riveted to webs of deep beams. Space utilized for ventilation, etc.

It is asserted that iron is unsuitable for fire proof construction, by reason of its failure when exposed to a certain degree of heat. That this is so is, of course, admitted; but, nevertheless, it is the only material at our disposal suited to modern requirements; and the architect will meet with more satisfactory results in devising means and methods for its protection against the destructive effects of fire than by discarding it.

Columns or girders of wood resist the destructive effects of fire much longer than if made of iron exposed. The necessary dimensions, however, except for comparatively light structures, are such as to make the use of wood for those purposes impracticable; for example: A column of oak 18 feet high and 1 foot square will support with safety 25 tons, while a hollow, cast-iron column, 1 foot square and 1 inch thickness, of metal, will support 119 tons. So, also, will a beam of yellow pine 15 inches square, 15 feet span, and uniformly loaded, carry 16 tons, while three 15-inch light rolled iron beams, lying side by side and occupying about the same space, will carry 69 tons.

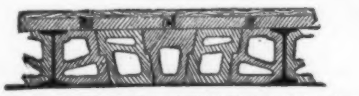


Fig. 2.—FLAT ARCH OF HOLLOW TILE, FROM 6 TO 14 INCHES DEEP.

CLASSIFICATION OF FIRE-PROOF STRUCTURES.

I divide fire-proof buildings into three classes:

Class I. embraces those structures in the construction of which only incombustible material is used, and all constructive ironwork is properly protected against the action of fire.

Class II. embraces those structures into the construction of which incombustible material enters, but the ironwork *not* protected by fire-proof and non-conducting coatings. Suitable for buildings not containing so much inflammable matter as to injure or weaken the iron in case of fire.

Fig. 3.—ARCHES OF CORRUGATED SHEET-IRON ABOUT NO. 20, B. W. G.

Weight of construction from 40 to 100 lbs. per square ft. *f*, corrugated sheet-iron arches up to 9 ft. span; rise of arch as desired.

Class III. comprises all buildings in the construction of which combustible material is used, but all vital members protected by fire-proofing.

DETAILS OF CONSTRUCTION.

Class I. or II.—In the construction of Class I. all combustible material is rigorously excluded, except for doors, window-sashes, stair-rails, flooring, and skirting. The external faces of outside walls may be either of brick, sandstone, or granite; the backing to be of brick with a hollow space 2 inches wide, located one brick distant from the inner face of the wall. All openings in the brickwork to be arched. Roof construction, furring, and lathing, of iron. The floors to be constructed of iron beams, supporting arches of brick (Fig. 1), hollow tile (Fig. 2), or corrugated sheet iron (Fig. 3); the haunches and crown to be filled with concrete, level with the tops of the beams.

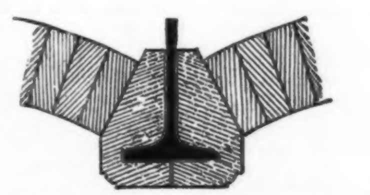


Fig. 4.—PROTECTION OF LOWER FLANGE OF BEAMS. CLASS I.

Burnt clay skew-back, formed to lap flange.

When floor-tiles are used they should be bedded in about 1 inch of cement, spread over the concrete; when of wood, wooden strips 2 by 2 inches, to which the flooring is nailed, are bedded on the concrete from 16 inches to 2 feet apart; the spaces between the strips being filled with cement mixed with fragments of porous brick.

Fig. 5.—PROTECTION OF LOWER FLANGE OF FLOOR BEAMS.

View from below. *a*, iron rods ½ inch diameter; *b*, flat hoop iron bent around flange, about 4 ft. apart; *c*, wedges; *e*, plaster.

Practically there is no difference between the above methods as to strength, but considerable in weight, the order

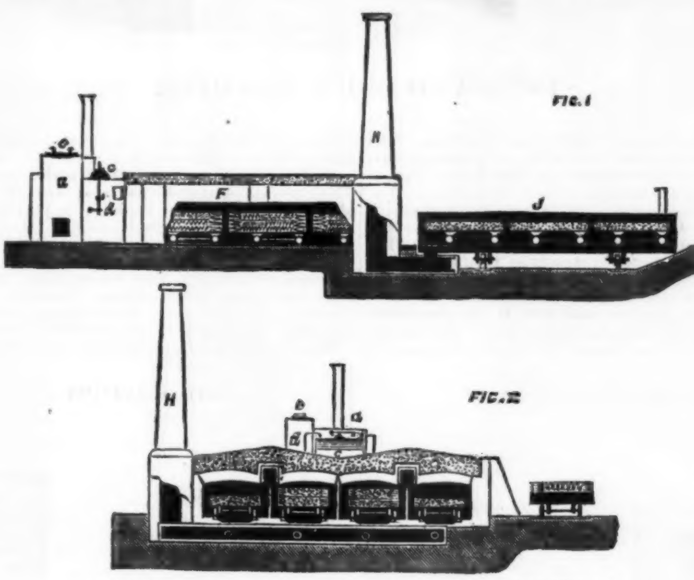
* A paper by F. Schumann, C.E., read at the last annual convention of the American Institute of Architects, reported in *American Architect.*

being as follows, commencing with the lightest: Hollow tile, corrugated sheet iron, brick. When ceilings are to be plastered the plaster is applied directly to the brick arches and hollow tile; the corrugated iron arches are merely painted. When flat ceilings are required iron lath is riveted to small ⊥ or T irons that run from and rest on the bottom flanges of the beams; the hollow tile is generally made for flat ceilings.

It is important that the soffits of beams and lath to iron girders receive a coat of some good fire-proof and non-conducting material, not less than 1 inch thick and securely fastened on. A mixture of asbestos and pipe-clay is very effective. The soffits of floor-beams may also be protected by the brick skew-backs of arches being made in such a form as to lap the lower flanges of beams (Figs. 4 and 5).

MANUFACTURE OF PEAT CHARCOAL.

The utilization of peat is one of the subjects for invention and the expenditure of capital which has always led to failure in this country. It seems, however, that the difficulties, both as regards cost and efficiency, which have hitherto attended efforts to make charred peat of commercial value, have now been overcome, though the fact that this has already appeared certain on many occasions suggests the necessity for caution. Some experimental works have been constructed at Medge Hall, between Doncaster and Crowle, and it appears that the work there being done was—as an experiment on a small scale—in every way successful. There are three of these experimental works now in use—the one above mentioned, one in Westmoreland, and one in Ireland. Under a modified form the process is being successfully worked in Transylvania. The cost of production has been obtained by accurately-kept accounts of every item of cost for a given time, at each of the three works referred to. In the Lincolnshire case, the cost of producing a ton of charcoal was 18s.; at the Westmoreland works it was 18s. 6d.; and at the Irish works, 18s. 9d.—showing a degree of uniformity which speaks well for the system. It is thought that by establishing larger works, at which both manual labor and heat could be economized, this cost may be reduced about one-fourth. This system is equally adapted for charring any animal matter, or wood, or other vegetable substances. The accompanying illustration, Figs. 1 and 2, will enable us to explain the apparatus employed.



MANUFACTURE OF PEAT CHARCOAL.

It consists mainly in arrangements for employment of superheated steam for conveying the heat from the furnace to the ovens in which the peat is placed. If a current were induced in the ordinary way by admitting atmospheric air through the furnace door, and allowing it to pass to the ovens, the oxygen thus supplied would be liable to support the combustion of the peat, which would probably take place as soon as most of its moisture had been driven off. Ovens of iron or brick, through which heat passes from the outside, and which would have to cool down again after the peat had been charred before it could be safely exposed to atmospheric air, or sealed ovens of any form or material, cannot, for the above reason, be employed. They are too costly, because too slow in working, to produce charred peat at a price that would admit of its general use for the purposes for which it is valuable.

The ovens are merely a number of brick arches, made of either common or fire-brick, the walls being perpendicular and the tops arched, the tops being covered with sand to check the radiation of heat, as seen in Fig. 2, which is a section of the ovens near the chimney. The two small squares between the tops of the first and second arches on either side are the flues along which the gases are sent from the furnace to the ovens. At the end near the furnace these flues converge, there being two pairs of ovens to one furnace, and by shifting a damper from one branch of the V to the other, the current of heated gases is diverted from one pair of ovens to the other. By this means both time and heat are economized; as after one pair of ovens has reached the temperature at which the peat becomes charred, viz., 750 degs. Fah., some time must be allowed for the peat to cool down before any attempt at its removal can, as above described, be made with safety. But it is essential to economy to maintain a high furnace temperature, and for this reason the plan of refilling one pair of ovens while the charring process is going on in the other, and then diverting the current of gases as soon as the charring has been completed, the arrangement described, became necessary, and is a good one.

The peat is introduced into the ovens in iron trucks formed of small bar iron and wire netting at the bottom. The trucks are 4 ft. 6 ins. in width, and 7 ft. in length, and as the ovens are about 22 ft. long, each one will hold three trucks at one time. The withdrawal of the truck needs some care. At J, Fig. 1, is a long box made of wood and sheet iron, with doors at each end. This box, it will be observed, is mounted on transverse wheels which run on cross rails. The left-hand end of this box is made to fit close up to the door of the ovens, although this is not shown to be the case in our drawing, and the rails to receive the trucks on the bottom of the box are on a level with the rails in the ovens. Opposite the ovens, and on a level with the rails in the box, J, are four sheet iron cooling boxes, with a door to each at the end nearest the oven. These cooling boxes are not shown in Fig. 1, but the door would be on the rising ground to the right, the door being close to the movable box, J. When an oven is to be emptied, this movable box is fastened between the oven and the cooling box, a rope and chain being simultaneously carried through the cooling house and movable box. The oven door is then quickly raised, the chain on the rope being already hooked on to a chain of the end truck, when the three trucks are rapidly drawn through the movable box into the cooling house, the trap door of which is instantly lowered. The temperature of the peat when charred is very great, and if it were allowed to cool down in the ovens till it was safe to let air in, or equally safe to draw the peat into the open air, days would be wasted over one cooling, while a great loss of heat would at the same time ensue. The object, then, of the cooling house and the intervening movable box, or middle passage, as we may term it, is that the hot charred peat may be passed from the ovens to the nearly air-tight cooling houses without coming in contact with a sufficient supply of oxygen to induce it to burst into a blaze, which would certainly be the result if an attempt were made to rush the trucks of peat across the intervening space of 22 ft. without excluding them from the air.

The superheating apparatus is both simple and efficient. A small boiler is placed horizontally across the top of the furnace. This is seen at *c* in each figure. Steam is raised in this boiler to a pressure varying from 50 lbs. to 80 lbs., according to the force required to carry the heat of the furnace into the ovens. This steam is conducted by an inch iron pipe, *d*, Fig. 1, to the superheater, which consists of three coils of similar pipe cast into blocks of iron about 18 ins. square and 2½ ins. thick. These piped blocks of metal stand one in front of the other in the hottest part of the furnace. The pipe, after leaving the last block near the entrance to the flues, is capped with a ⅛ in. nozzle pointing in the direction of the flue to the ovens. This steam is very highly superheated, and its heating power and capacity for absorbing moisture from the peat very great, while the velocity with which it issues from the jet produces a strong current in the flues, and carries the products of combustion from the furnace with it. The furnace door is kept closed except when fuel is supplied, so that all the air there for supporting combustion in the furnace is forced through the grate, and by the time it has reached the top of the fire almost all the oxygen has been appropriated, and the arrangement secures the thorough consumption of all smoke.

The exit of the vapor during the drying, which precedes the charring, is by flues at the bottom of the ovens. The openings are seen at the bottom of the ovens in Fig. 2, and the larger cross-flue for carrying the vapor to the shaft, H, may be detached to the right of the base of the shaft in Fig. 1. In each short flue, between the ovens and cross-flue, there is a damper to regulate the escape of vapor, and also to check the escape of heat at a late stage of charring. Thus heat is economized to the nearest degree. In each oven is inserted a pyrometer, and the dampers in the escape flues are regulated by these. During a recent experiment the heat had reached 400 degs. Fah. in the ovens after the current of gases from the furnace had been turned into them one hour and a half, yet the damper was withdrawn about 8 ins., or two-thirds the depth of the flues, and much vapor was still escaping. This escape of vapor, after such a time, and at such a heat, we may add, was due to the peat used having been taken from the open moor direct, no drying sheds having as yet been erected in connection with these experimental works. This process, indeed, is so efficient that it takes only about five hours to convert common air-dried peat, that contains from 40 to 50 per cent. of moisture, into perfect charcoal.

The small funnel over the furnace at the left-hand side of Fig. 1, and marked *a* in Fig. 2, is merely for use while getting up steam. When this has been done a damper prevents any draught through it.

The valuable uses to which peat charcoal may be turned, now that it can be produced at the price above mentioned, are very numerous; of the material itself there is an almost inexhaustible supply. At the Medge Hall moor there are 5,000 acres, varying in depth from 6 ft. to 15 ft. If, too, 6 ft. or 7 ft. of this peat be pared off, and utilized as peat charcoal, then the whole extent of the moor could be warped by the thick water of the tidal portion of the river Trent, and thereby converted into the most fertile lands. There are many other moors and bogs in England, Scotland, and Ireland that could be profitably reclaimed in a similar manner. For sanitary purposes its value is well known, but for agricultural purposes it is much required. For making the refuse of fish, or putrid fish, and the offal of slaughter-houses inodorous and portable it may be employed with advantage from a sanitary point of view, and profitably in restoring the fertility of exhausted pastures and arable soils. For absorbing urine, and fixing its ammonia at the same time in drains, and tanks of stables, cow-house and piggeries, it may be used with great benefit, both as a preventive of noxious effluvia and as a means of making this valuable liquid easily portable and easily distributable over cultivated lands. Not only is it an excellent fertilizer for all soils deficient in organic and carbonaceous substances, but it may be made the agent for preserving and economizing many forms of animal excreta that are now allowed to run to waste down drains, or are washed away intentionally with a view of getting rid of them with as much readiness and as little trouble as possible.

The Westmoreland works were established for making peat charcoal for fuel. In this case it is necessary to macerate and condense the raw peat, which is then formed into "bricquets;" and when they are sufficiently dried in the air they are charred in exactly the same way as above described. The inventor is confident that, through the means of such charcoal, a revival of the production of iron by the use of charcoal will take place. Indeed, a company is being formed in Devonshire for utilizing the peat of Dartmoor by this process, and subsequently for smelting the valuable stratum of iron ore which has recently been discovered there.

It is possible that Mr. Barff's system of peat charring may create new industries of great extent and importance.—*Engineering.*

SOLUBLE TANNATES OF SODA.

Boiler incrustations, so unpleasantly well known to almost all users of steam power, are produced by the precipitation of the lime compounds (chiefly carbonate and sulphate) contained in all hard waters in the form of a hard, adherent crust upon the boiler plates. The precipitation is brought about by the combined action of heat and evaporation upon the water. The heat is chiefly instrumental in depositing the carbonate of lime, as it expels from the water the carbonic acid gas by which it has been enabled to dissolve the lime salt. Evaporation, on the other hand, has the greater share in depositing the sulphate of lime. Boiling water, under a pressure of 60 lbs. to the square inch, will hold in solution about 1-1,000 of its weight of gypsum or crystallized sulphate of lime. Consequently, whenever the water in a boiler is evaporated down until it contains more than this proportion of gypsum, the excess over this quantity begins to deposit as a crust on the plates. Sulphate of lime crusts are harder and adhere more firmly than those in which carbonate of lime predominates.

If a water contains sulphate of lime only, as is sometimes but not generally the case, a knowledge of the degree of solubility of this salt in boiling water, as explained above, will often enable the user to keep his boilers free from incrustation, by taking care never to evaporate beyond the point at which the water will just hold the salt in solution, *i. e.*, when 1,000 parts of the water contain 1 of gypsum. For instance, if a water containing, say, 17 grains of gypsum per gallon, and little or no carbonate of lime, be used, all that is necessary to prevent incrustation is to blow off regularly, or renew the supply when the water introduced into the boiler has become reduced to one-fourth of its bulk. That is, three-fourths of all the water put into the boiler may be converted into steam without causing the formation of a crust, but the remaining one-fourth has to be blown off at a boiling temperature, causing thereby a great loss of heat. When, as is most frequently the case, the water used contains both carbonate and sulphate, this plan will be only partially successful, as the carbonate of lime is not contained in the water by virtue of its mere solubility (which is extremely small), but is held in solution by the presence of free carbonic acid gas. This gas is expelled at a boiling heat, and a deposit of carbonate of lime is then produced, irrespective of the degree of concentration of water. As remedies for these cases scores of substances have been proposed, which, on addition to the water, are expected to exercise a mechanical, chemical or galvanic action that shall prevent the incrustation. Thus, as a means of curing carbonate of lime incrustations by chemical action, sal ammoniac or chloride of ammonium has been proposed. This salt decomposes carbonate of lime, and we get instead carbonate of ammonia and chloride of calcium—the former a salt so volatile that it is carried away by the escaping steam; the latter a salt which is extremely soluble in water, and which therefore does not deposit unless the boiling is carried to absolute dryness. But this is by no means a universal remedy. For many purposes the presence of carbonate of ammonia in the steam is highly objectionable; sulphate of lime is not removed by the process, and it is said (we do not know how far the statement is warranted by actual experience) the sal ammoniac causes corrosion of the boiler plates. It is clear that for a given substance to have no injurious action on the boiler metal is quite as important as that it should be effectual in removing or preventing incrustation. One of the most successful means of preventing incrustation without injury to the boiler, and without contaminating the steam, is the employment of alkaline solutions containing tannin or similar organic substances. The action in these cases is part chemical, part mechanical. The alkali causes the precipitation of the lime salts, and the tannin has the important property of causing the precipitate to form of a slimy consistency, so that it will not adhere to the plates, and can be blown out periodically with the water. Messrs. Cooper & Smith, Morville Street, Birmingham, have sent us for analysis two samples of products of this class, which they call soluble tannates of soda, and distinguish as "Crystal Tannate" and "Fluid Tannate" respectively. The results of the analysis may be expressed as under:

CRYSTAL TANNATE.

Crystallized carbonate of soda	93·5
Tannin	1·2
Moisture	5·0
Insoluble organic matter	0·3
	100·0

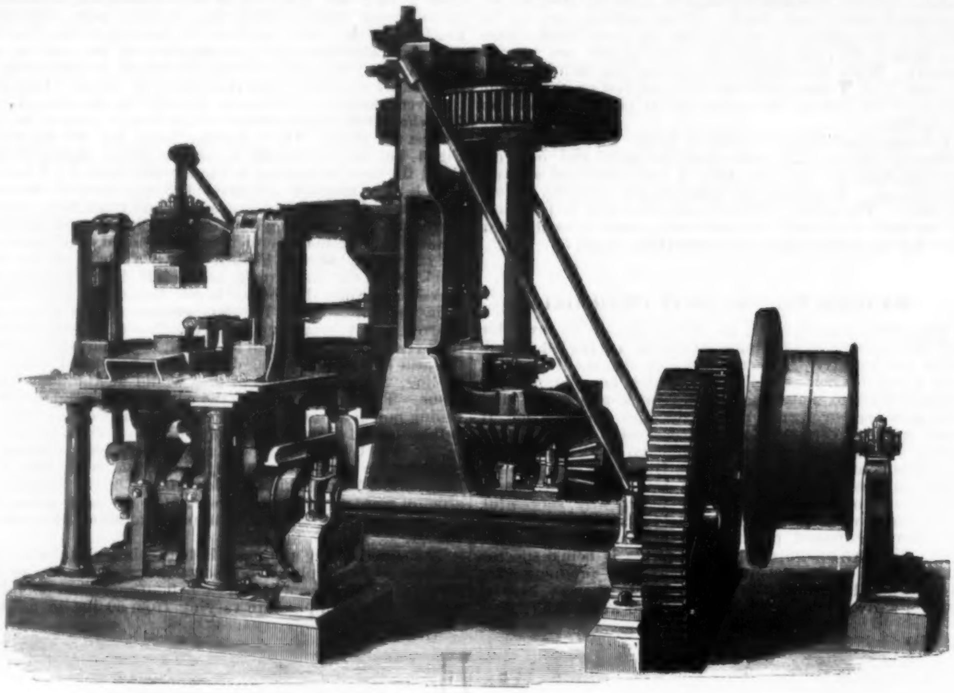
FLUID TANNATE.

Water	72·6
Crystallized carbonate soda	25·1
Tannin	1·4
Other organic matter	0·9
	100·0

The fluid tannate is thus a solution of tannin in carbonate of soda, and contains about 12 per cent. of dry matter, containing about 12 per cent. of tannin. The liquid has a specific gravity of 1·105, and is of a deep red color, due to slight oxidation of the tannin in contact with the air. The "crystal tannate" is similar in composition to the fluid, but the carbonate of soda is in the crystalline state instead of dissolved in water, and the proportion of tannin to soda is less than in the fluid. Both samples are perfectly soluble, and contain nothing that could pass over with the steam. As a proof that the mixtures do not corrode metal, the manufacturers export them in iron drums, and refer to the experience of their customers. Numerous testimonials from large steam users attest the advantage to be derived from the use of these substances, both as regards the disintegration and removal of old incrustations and prevention of new ones.—*Textile Manufacturer.*

IMPROVED BRICK MACHINE.

The driving pulleys, moving at high speed, are seen to the right of the illustration. This first shaft, which is carried on an outside bracket, gears by means of a pinion into two equal cog-wheels, which drive, respectively, the one the upright pugging shaft and top mould, and the other the final finishing press. This latter press is formed by an overhead cross-head carrying a stamp, and connected with the shaft below by two cranks and connecting rods. This crosshead and stamp descend into the die in the table below into which the brick has been delivered, and finally compress and harden it. Underneath the table and die is another revolving crank or cam, which, as it rises, pushes the finished brick from the mould ready for delivery. As all these actions are automatic, the only labor required is that of one boy to remove the bricks to the kiln trucks or barrow. The machine is very powerfully built, and we see that a good deal of the gearing is mortise-toothed, and therefore of the best quality. The power required to drive the machine is stated to be from 8 to 10 horse (according to the state of the clay), and it will deliver 10,000 bricks per day. This seems a well-designed machine. Bradley & Craven, makers, London.



IMPROVED BRICK MACHINE.

IMPROVED GAS GLASS FURNACE.

We illustrate a very simple form of automatic gas generating furnace, applied by the patentee, Mr. J. Pellatt Rickman, to glass-melting and other furnaces. By its use in the former application, great economy in the first cost of the glass furnace and shaft is secured, those as erected at Messrs. Pellatt & Company's new glass works, Old Kent-road, London, having cost about one-half that of a furnace for the same number of pots, and constructed with the old form of cave and high shaft, the saving of fuel being almost as great. Referring to our illustrations, Figs. 1, 2, and 3 of which represent one of the furnaces employed at Messrs. Pellatt's works, it will be seen that they are arranged for six melting pots, Fig. 3 being a part front elevation. The furnace proper is most clearly seen in Fig. 1, which is a vertical section of the whole furnace on the line A B of Fig. 2, which is a horizontal section on the line C D of Fig. 1. The furnace proper or gas generator will be seen to consist of a fuel chamber under which is a gas chamber, and under that the fire chamber with appropriate gas and air flues. The three chambers are connected vertically so that the coal or other fuel falls as required into the gas chamber, and the coke from the gas chamber into the fire chamber.

Referring to Fig. 1, A is the coal box, B gas generating chamber, C fire-bars, D ignition chamber where gas and air mix, E air flues to ignition chamber, F throat of furnace, G clinkering door, H evaporating pan, I coaling door, K glass furnace flues to each pot, L general flue to same, B' glass melting pots, N searching flues under pots, E' chimney. The gas is distilled at B, passes down and meets with the air passing through the fire-bars, is partially ignited there and enters fully into combustion at D with the air mixed with it in its passage through F, past E. The air passages are maintained at a red heat, so that the ignition chamber is supplied with air at a high temperature. If a deoxidizing flame is required in the utilizing chamber, the air flues are wholly or nearly closed. With ordinary steam coal the fire requires clinkering at G once every ten or twelve hours.

The furnaces have now been in successful work for some

FIG. 1

VERTICAL SECTION ON LINE A.B. IN PLAN

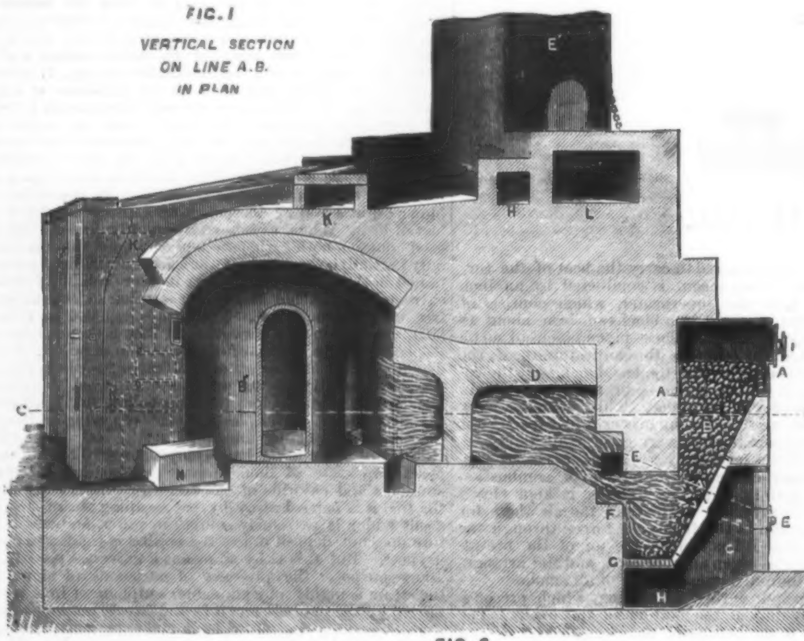
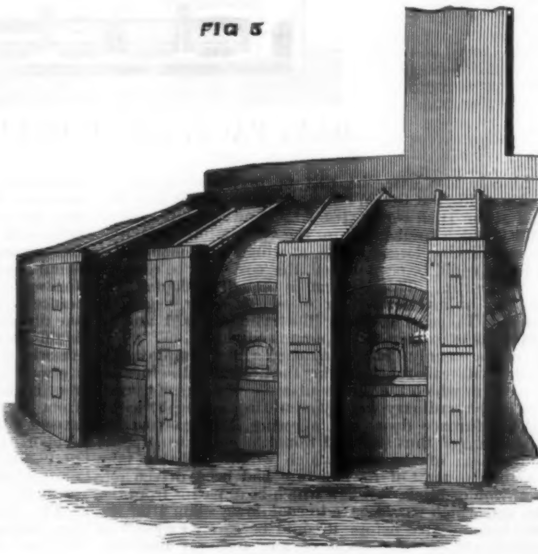
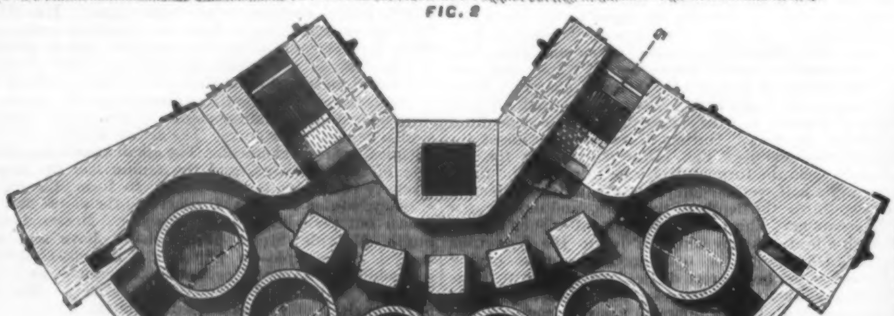


FIG. 2

PART ELEVATION

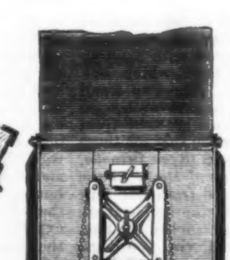
FIG 3



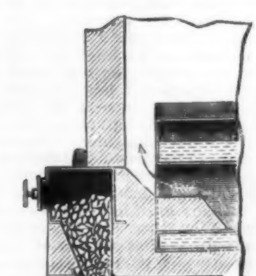


HORIZONTAL SECTION ON LINE C. D.

FIG. 4



FRONT ELEVATION



VERTICAL SECTION

RICKMAN'S IMPROVED GAS GLASS FURNACE.

time; the task of stoking is very light, and the temperature of the stokehole very much less than that with an ordinary furnace. By means of the arrangement of air flues the quantity of gas generated and the temperature of the glass furnace may be regulated with great precision, the furnace being, of course, smokeless. For a six pot glass furnace each grate surface is 20 ins. by 24 ins., and burns about 14 lbs. of coal per square foot per hour. Each coal box holds about 2 cwt., and coaling is required about every five hours. The furnace is shown at Fig. 4 as applied to a Cornish boiler, and this application of the gas furnace promises to effect as great a saving in labor and fuel as has already been secured in the glass furnace.—*Engineer.*

GAS GOVERNORS.

MR. W. WHITE's automatic valve-governor is exhibited in the annexed woodcuts, Figs. 1 and 2, which are a vertical section and an elevation with lid removed to show the interior of valve-chamber. In a cast-iron box or chamber is contained a flap-valve, hung by a strap, and hinged at two places to insure the metallic valve, which is faced, always coming into close contact with the seat. This latter is at a slight inclination from the vertical, so that the tendency of the valve is to close. For the purpose of weighting the valve to the pressure desired, a pipe, A, is brought to the surface, through which lead shot is dropped into the pocket fixed to the back of the flap. A siphon-box is attached to the bottom of the governor to receive the fluids condensed in the main,

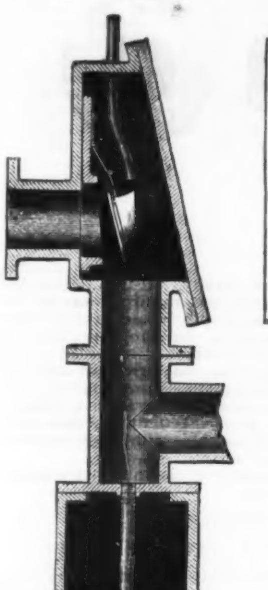


FIG. 1.

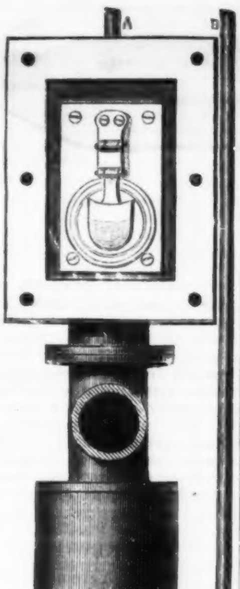


FIG. 2.

the vertical pipe, B, shown in Fig. 2 being for the purpose of applying a pump at the surface for emptying the same.

A compact and useful district governor has been invented by Mr. W. Foulis, and is illustrated in Fig. 3. This apparatus, which is made by Messrs. W. & B. Cowan, is altogether novel in design; and, being most sensitive in its action, and occupying the minimum of space for a wet governor, it is peculiarly valuable for the purpose intended. The drawing represents one for an 18-inch pipe, and is to a scale of three-fourths of an inch to the foot. The outer case, A A, is of cast iron, closed both at top and bottom,

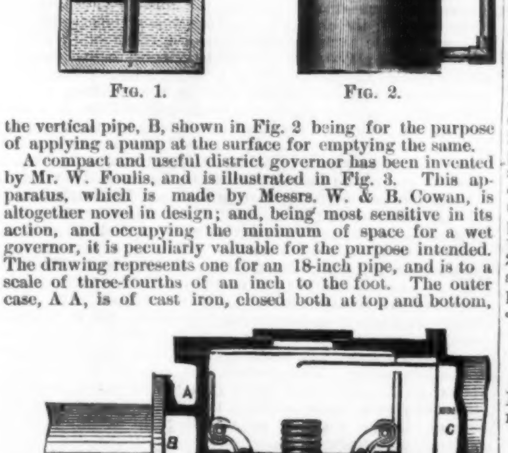


FIG. 3.

and having a valve-seat, D D, cast within it. B is the inlet and C the outlet pipe. The valve, E, is formed of two inverted cones, having a cylindrical prolongation, with the necessary float, the object of making the cone double being to neutralize the effect of the inlet pressure; or, in other words, to prevent the inlet pressure from exerting any influence on the action of the governor. In order further to attain this object, the triangular space formed by the two cones is inclosed by a continuation of the cylindrical portion of the valve. In this, slits are cut of sufficient area, and so adjusted that when the valve is open to the full, the area of the portion of the slits below the valve-seat is rather greater than that above it, thus establishing a uniform pressure in the triangular space, and so equalizing the pressure on the two conical surfaces.

A small pipe, F, is led in at the bottom of the outer case into the interior of the valve. The valve is guided by three pulleys fixed on its top, and the same number of pulleys attached to the outer case at some distance from the bottom. By this arrangement the valve may be withdrawn on removal of the top cover. The vessel is charged with glycerine to prevent freezing. The apparatus is used as a station governor, but it is with its arrangement as a district governor that we are now dealing. When the pipe, F, is connected with the inlet-pipe, and the float loaded to the required amount, the governor is differential in its action—that is to say, the difference between the inlet and outlet pressures is constant, thus enabling the pressure on the district governor to be reduced to any required extent below that at the works.

The differential governor of Mr. H. E. Jones is exhibited in the accompanying drawing, Fig. 4. It consists of a cast-iron box, divided into two chambers, upper and lower, by a central diaphragm division-plate, on which is supported a vertical pipe; the diaphragm has slotted holes on its side near the top, which latter may be surmounted either by a flat plate or by an upright cone. If the former be used, a conical collar or ring is attached to the under side of the crown of the holder, and seats itself on the plate; but if a cone be employed, the ring is less in depth, and is made, as

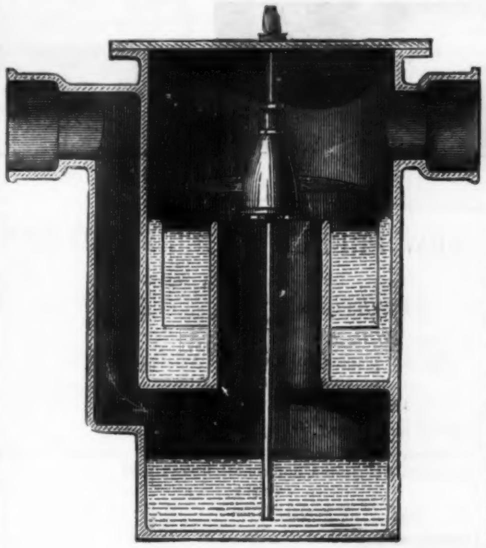


FIG. 4.

usual, to fit the cone base. When the governor is fixed in the line of main, it has no communication with the atmosphere, for the small vertical pipe is intended only for the attachment of a siphon-pump, and is capped in the ordinary way.

The action of the apparatus is as follows: The gasholder being weighted so as to require, say, 6-10ths of an inch pressure to raise it, the gas, on entering the bell, has first to overcome its resistance, and if the incoming pressure is less than 6 10ths, it is evident that the holder will not be raised from its seating, and therefore no gas can pass. If, however, the pressure exceeds the 6-10ths, the gas holder is lifted, but only such quantity of gas passes as is due to the pressure in excess of 6-10ths, for that pressure must of necessity be maintained underneath the bell in order to support it. Thus suppose the pressure on the inlet to be 10-10ths, then that on the outlet will be 4-10ths; on increasing the pressure on the inlet to 20-10ths, the outlet pressure becomes 14-10ths, and so on. Consequently the governor responds to changes in the initial pressure at the works during the hours of day and night.—*Journal of Gas Lighting.*

TRANSMITTING GAS.

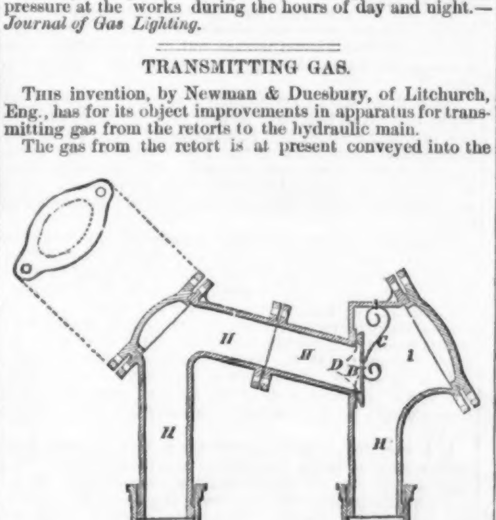
THIS invention, by Newman & Duesbury, of Litchurch, Eng., has for its object improvements in apparatus for transmitting gas from the retorts to the hydraulic main.

The gas from the retort is at present conveyed into the hydraulic main by a pipe dipping into the liquor contained in the main, so that the gas has to force its way through the liquor. This invention is to obviate this, by so constructing the pipe hereafter described, which forms the connection (with the pipe G) between the ascension-pipe and the hydraulic main, that it will contain a chamber.

In the annexed drawing, the pipe, H, H, H, which forms the connection between the ascension-pipe, E, and the hydraulic main, F, is constructed in two parts, one part so that it will contain the chamber, A, for the purpose of allowing the clack and spring to work. In this chamber are placed a clack and spring, marked B and C, also a smooth face-plate, marked D, for the bed of clack, which will open when carbonizing coal, and instantly close against all back pressure. G is the dip-pipe connecting the pipe, H, with the hydraulic main, F.

The gas will be delivered into the hydraulic main, F, free from any seal or dip, thus removing all hydraulic pressure from the retorts, and thereby lessening the formation of carbon on the retorts, and giving an increased yield of gas from the coal carbonized. The effect will also be to carbonize the coal in less time, and to lengthen the durability of the retorts.

The apparatus, being self acting, removes the absolute necessity for exhausters or engines.



TRANSMITTING GAS FROM THE RETORTS TO THE HYDRAULIC MAIN.

AIR SHIPS.

By R. GRIMSHAW, C. E.

THERE are two principal systems proposed for aërial navigation: first, devices lighter than air, or aërostats, which rise and maintain themselves at a height by reason of their very light density, so that it is merely necessary to guide and move them; second, apparatus heavier than air, which must be raised, moved, and guided mechanically. This latter class has two subdivisions: aëroplanes, consisting essentially of a plane, moved by some motor (as a screw or other device), and sustained by the resistance of the air to their movement; and apparatus endeavoring to imitate exactly the flight of a bird.

The first of these three systems of propulsory aërostation is best represented by the Dupuy de Lôme apparatus. This is a balloon so elongated as to present the least possible resistance to displacement of the air, propelled by a screw, and guided by one or more sails acting as rudders. The screw is carried by the car so that it draws the balloon; and from this results an "*unleveling*," increasing with the speed.

The second system is generally called *aviation;* and we will describe two modes of attempting it.

The first is that of Mr. Pénaud. His little model flew a long distance. It had a screw propeller in advance, and on its axis prolonged there was a light rectangular plane, with its longest sides parallel to the screw-shaft. On each of these sides is hinged a nearly semi-elliptical wing, which can be inclined to the plane of the parallelogram. The forward edge of these wings is a little raised. On their rear side, terminating in a straight line, are hinged two rudders—one for each wing. In this test apparatus the rotation of the screw was accomplished by the torsion of an India-rubber cord. The car should be below the wings. The principal plane of the apparatus and the lines of hinging are in the plane of the screw propeller. The wings being disposed symmetrically, the device resembles a huge butterfly.

The second apparatus, on the same general principle, is that of Mr. Du Temple. It has the form of a great bird. The body is a lattice car like a pilot boat, containing a steam engine for operating a screw propeller placed ahead of the boat-car with its shaft resting on its bulwarks and in the plane of symmetry. The wings are of light frame-work, bound tightly to the car, on which they rest. They are perfectly rigid and cannot flap like the wings of a bird. Thus, the bulwarks of the boat, the wings, and the axis of the screw are in the same plane, in this not differing from Pénaud's plan. Astern there is a vertical rudder and a horizontal tail, hinged horizontally. On the ground, the device rests on three feet supplied with rollers, and so arranged as to incline the apparatus about 20°, the stern being the lower The screw is 4 meters in diameter and has 12 wings, appearing to cover ⅔ of its circle. The pitch is 12 meters. The wings seem to have about 50 square meters surface, and the tail 12 square meters; the car being 4 square meters in plan. According to the author a force of 6 horses is necessary to propel the apparatus (which weighs 1,000 kilogrammes) at a rate of 9 meters per second.*

The third plan, trying to imitate the flight of birds, is yet in the theoretical stage.

It may be well in choosing among these three systems to look into the principles of flight, and first into the action of the air on a moving plane.

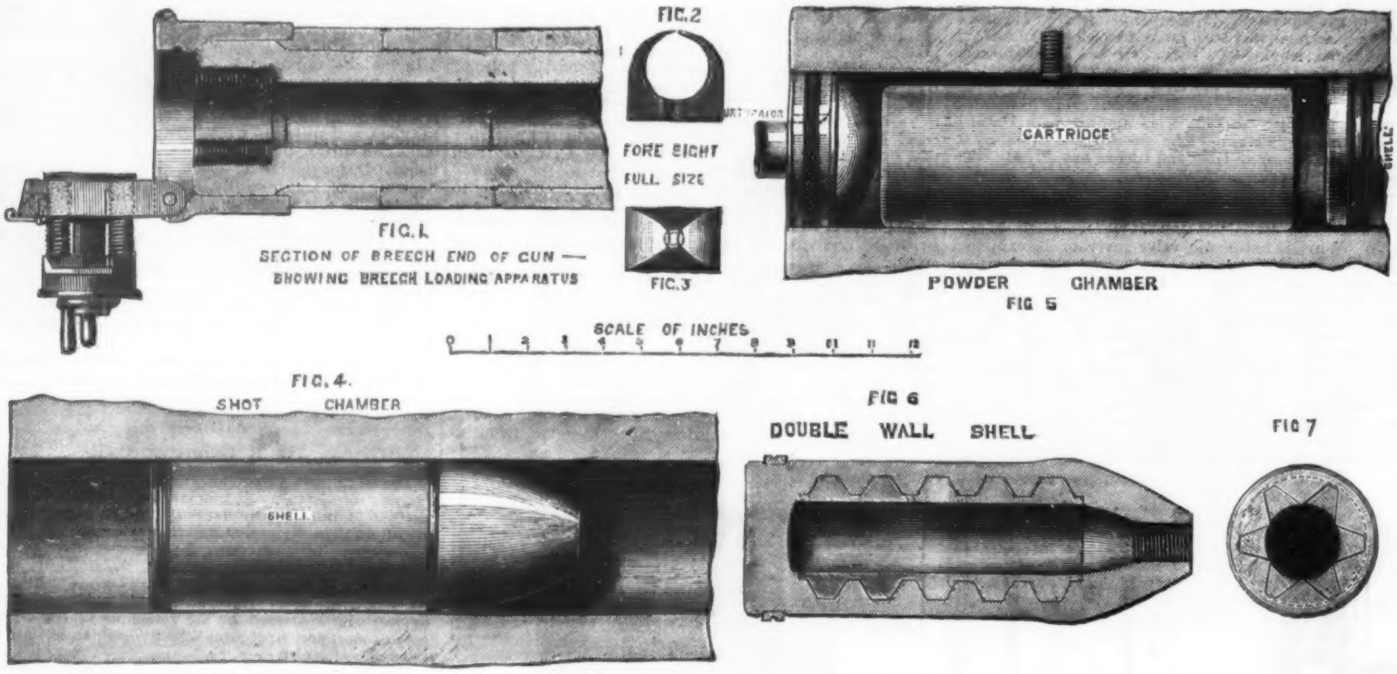
The pressure of the air on a plane depends solely upon the *relative* velocities, no matter what the *absolute* velocities, of the air and of the plane. We shall consider a horizontal plane and a horizontal direction of the wind.

If a plane heavier than air, and remaining horizontal, be abandoned in the air, it will fall, whether it has velocity horizontally or not; for nothing, under these conditions, can annul the effect of gravity. For a plane heavier than air to be sustained therein it must be oblique and have a certain horizontal movement (or else be sustained by an upward force).

To find the resistance of the air to the movement of a plane inclined to the direction of its movement, it suffices to know this resistance for the translation,† at the same speed, of a plane perpendicular to its motion, and to apply to this resistance a certain coefficient. Omitting minor considerations of friction, air-currents, etc., it has been shown that the work of translation in air is proportional to the surface, to the cube of the sine of the angle of incidence of the wind, and to the cube of the velocity of the wind. Also, that, providing that the angle of a plane moving in the air is maintained at the minimum necessary to sustain its weight, the work of translation diminishes as the speed increases; and that there is an advantage in making the planes of an "aviator" as large, and their angle as small, as possible. The resistance to translation of a sphere is half that of its great circle; and that of an equilateral half spindle is only $\frac{1}{14}$ that of its great circle. Dupré has stated that for high speeds a half-sphere or a half-spindle bears the calculated pressure on only part of the surface; there being even a vacuum or aspiration on part of it, due to a conical film of air following the advancing body. It is thus

* Really, with a surface of about 66 sq. meters, this aëroplane would require, with an angle of 20°, a speed of 32 meters to sustain it, and the propelling force would be about 154 H. P. At a speed of 9 meters, and an angle of 20°, it would need to sustain it 826 sq. meters of surface, and a propelling force of 43 H. P.

† The word translation is employed, to save circumlocution, to denote motion from place to place.



NEW FRENCH STEEL FIELD GUN.

desirable so to shape the aviators as to avoid these eddies.

To compare the work of translation in different systems we must take as a common base a common weight of apparatus and a common speed—at least equal to that of an ordinary wind, say 10 meters per second. With a device weighing 1,000 kilogrammes the following results are found:

Velocity of Wind.	Pressure per Square Meter.
10 meters per second.	13 kilogrammes.
15 " " "	30 "
20 " " "	54 "
30 " " "	122 "
45 " " "	277 "

An ordinary spherical aërostat weighing 1,000 kilog., filled with hydrogen pure enough to support 1 kilog. per cubic meter, should have for diameter

$$\sqrt[3]{\frac{1000 \text{ cu. m.} \times 6}{3{\cdot}14}} = 12{\cdot}40 \text{ meters.}$$

The work of translation of the balloon alone (not counting the car) would be

$$\tfrac{1}{2} \times \frac{3{\cdot}14 \times (12{\cdot}40)^2}{4} \times 13 \text{ k.} \times 10 \text{ meters;}$$

or about 104 H. P.

Two equal aërostats, of length six times the diameter, would require a diameter of

$$\sqrt[3]{\frac{12000}{106{\cdot}76}} = 4{\cdot}83 \text{ meters each;*}$$

and the work of translation would be

$$\tfrac{1}{2} \times \frac{\pi\,(4{\cdot}83)^2}{2} \times 130 = 2380{\cdot}71 \text{ kgm.,}$$

or about 31 H. P.

Two aërostats, of ten diameters in length, would require † a diameter of

$$\sqrt[3]{\frac{12000}{58\pi}} = 4{\cdot}03 \text{ meters;}$$

and the work of translation would be

$$\tfrac{1}{2} \times \frac{\pi\,(4{\cdot}03)^2}{2} \times 130 = 1657{\cdot}71 \text{ kgm.,}$$

or about 22 H. P.

For reasons of construction two symmetric aërostats are recommended, although one requires less power. A simple aërostat of ten diameters in length would require a diameter of

$$\sqrt[3]{\frac{12000}{29\pi}} = 5{\cdot}09 \text{ meters;}$$

and the power to work it would be, instead of the 22 H. P. of the last example of twins,

$$\tfrac{1}{2} \times \frac{\pi\,(5{\cdot}09)^2}{4} \times 130 = 1321{\cdot}96 \text{ kgm.,}$$

or only about 17·6 H. P.

Ease of construction would also point to a hemispherical cap. Now if, preserving the same diameter as in the last example, the length were so modified as to have it in form of an equilateral half-spindle, the work of translation would be only

$$\tfrac{7}{12} \times 1321{\cdot}96 = 771{\cdot}14 \text{ kgm.,}$$

or only about 10·28 H. P.

We will now suppose an aëroplane weighing in all 1,000 kg., and moving horizontally with a velocity of 10 meters per second. To have the least dead weight, it must work at an angle of 54° 44′; and then the work of translation would be

$$1000 \times 10 \text{ meters} \times \frac{\sin. 54^\circ 44'}{\cos. 54^\circ 44'} = 14{,}088{\cdot}69 \text{ kgm.,}$$

or about 187 H. P.

This aëroplane would have for aviating surface

$$\frac{1000}{13 \sin.^2 a \,.\, \cos. a} = \frac{1000}{13 \times 0{\cdot}385} = 199{\cdot}98$$

square meters (say 200 sq. m.).

To move at an angle of 14° (of which the tangent is about ¼) it must sustain a horizontal pressure of

$$\frac{1000 \text{ k.}}{200 \text{ sq. m. } (0{\cdot}0568 - \sin.^2 14^\circ \,.\, \cos. 14^\circ)} = 88 \text{ k.,}$$

corresponding about to a speed of

$$\sqrt[2]{10^2 \frac{88 \text{ k.}}{13 \text{ k.}}} = 26 \text{ meters; and the}$$

work of translation at this speed would be

$$26 \text{ m.} \times 88 \text{ k.} \times 200 \text{ sq. m.} \times (0{\cdot}0142 - \sin.^3 14^\circ) = 6497{\cdot}92 \text{ kgm.} = 86{\cdot}63 \text{ H. P.}$$

But if one had made the aëroplane with a surface sufficient to sustain it at an angle of 14°, at a speed of 10 meters a second, the power required at that speed would be only

$$1000 \text{ k.} \times 10 \text{ m.} \times \frac{\sin. 14^\circ = 0{\cdot}242}{\cos. 14^\circ = 0{\cdot}97} = 2494 \text{ kgm.}$$

about 33 H. P.

This surface would be

$$\frac{1000 \text{ k.}}{13 \sin.^2 14^\circ \,.\, \cos. 14^\circ} = 1354 \text{ square meters.}$$

Now while this angle of 14° is not very small, it is evident that it would not be practicable on account of the immense surface required.

Not only the aëroplane, but the oblong balloon terminating in a spindle, necessitate too much power to be practicable, not only with known motors, but even with those which it is hoped to build. We will then consider the "mixed aëroplane."

Suppose we have a rectangular aëroplane carrying a prismatic aërostat so that their vertical projections in the direction of travel are one; that is, an aërostat comprised between a horizontal plane cutting the upper edge of the aviator plane and three vertical planes cutting the three other edges. In this way the aërostat would present no resistance proper to translation; that resistance being entirely utilized to sustain it.

Suppose an aviator plane with a surface $S = nc^2$, mounted on a prismatic balloon as just explained; p be the total weight, a the aviating angle and d the weight lifted by a cubic meter of the gas:—say $p = 1000$ k., $p_a = 13$ k., $d = 1$ k., $n = 2$, $a = 54° 44'$; then $500 \text{ k.} = 5{\cdot}005c^2 + 0{\cdot}472c^3$; and c (the side of the plane) would be about 7·62 meters; the power required would be $2c^2 (0{\cdot}543 - \sin.^3 a) \times 13 \text{ k.} \times 10 \text{ m.} = 8197$ kgm. = about 109 H. P. If, other things being equal, $n = 4$ (that is to say, $S = 4c^2$), $1000 \text{ k.} = 5{\cdot}005 \times 4c^2 + 0{\cdot}472 \times 8c^3$; and c (or the length of the plane) = 5·06 meters; the power would be $4c^2 \times 0{\cdot}543 \times 130 = 7228$ kgm. = about 96 H. P.

It is easy to see how rapidly the power required diminishes with n (nc being the oblique area of the plane). Now suppose the cube of the prismatic aërostat doubled by such a symmetric increase that the vertical projection opposed to the wind is not altered. Then $1000 = 5{\cdot}005 \times 4c^2 + 0{\cdot}472 \times 16c^3$; and $c = 4{\cdot}35$ m. The power required would be $4c^2 \times 0{\cdot}543 \times 130 = 5342$ kgm. = about 71 H. P.

All the above examples are for a speed of 10 meters per second. An increase of speed would bring about a lessening of power required and of the weight of the motor. This is true or the simple aëroplane, but is it for the *mixed* one? For, increase of speed implying diminution of angle, there would be needed a prismatic aërostat smaller than that calculated, so that a downward pressure of the air above should not be produced when the angle is closed; and in consequence the final result could not be bettered.*

The difficulty might be practically obviated by allowing a certain liberty of diminishing the aviating angle without a downward pressure being produced:—making the prismatic aërostat with a horizontal lower face and an oblique upper face, without changing either its volume or (very much) the position of its center of gravity. It then follows that for a speed of 10 meters, suitably formed aërostats are better than aëroplanes. If the speed increases beyond 10 meters, the advantage approaches to the aëroplanes, up to the limit exacted by their fixed elements. But either system would demand a propelling force much greater than is possible with known or probable motors; for the figures above are rather under than up to those which practice would give.

The "mixed aëroplane" is much better than either of the pure systems, and appears practicable with known motors if made extraordinarily light.

What can American inventive genius and practical skill do in this important direction?

$$* \ 1000 \text{ cu. m.} = 2\left\{\frac{\pi d^3}{6} + \frac{5\pi d^3}{4}\right\} = \frac{34}{12}\pi d^3$$

$$† \ 1000 \text{ cu. m.} = 2\left\{\frac{\pi d^3}{6} + \frac{9\pi}{4} d^3\right\} = \frac{58}{12}\pi d^3$$

* A proper solution of this question requires an equation of the sixth degree; hence test cases are used here.

THE NEW FRENCH STEEL FIELD GUN.

THE French are now introducing a new steel gun for field service, in which are embodied the principles now adopted by most powers—that is to say, the gun is very long; the bore is small; the chamber is enlarged, and the cartridge has a considerable air space round it—the effect of these features being to allow of a very high velocity being obtained at the cost of the waste of some powder, a large charge being employed, which acts on the shell in a way which we may describe as being as much of a push and as little of a blow as may be. The gun by this means is subjected only to a comparatively low pressure, but will recoil very much if not checked by means of brakes. The gun being a breech-loader, the above arrangements can be carried out more completely and perfectly than in the case of a muzzle-loader, for the chamber can be enlarged to any desired extent without necessitating any such device as an expanding cartridge, which would, beyond a certain point, be a necessity in a muzzle-loading gun with an enlarged chamber. The shell also in a breech-loading gun is always driven up to the same distance when rammed home, being stopped when it is gripped; whereas in muzzle-loading a projectile is generally simply forced home on the cartridge, which may set up more at one time than another, either from harder ramming or other causes. This insures the powder being always burnt in the same sized space in a breech-loader, and consequently under more uniform conditions than in a muzzle-loader. Hence there is an advantage in accuracy on the side of the former.

The following are the details of the French piece in question, as given in an official translation by Major Owen, R.A.: The gun is made of cast steel, strengthened by six rings of puddled steel shrunk upon the inner tube. The second ring from the muzzle carries the trunnions, and the first ring is shrunk not only over the tube, but also over a securing ring. This arrangement gives much more power than the mere grip of the ring by shrinking to resist the tendency of the trunnion rings to slip forward upon the shock of discharge. The securing ring is embedded for half its thickness in a groove cut round the exterior of the steel tube, and for the other half in the front strengthening rings. It is put on in two pieces. The several strengthening rings are shrunk on in the following order: First the fifth, then the fourth, third, second—carrying the trunnions—the first, and finally the sixth.

The vent is of hardened copper, threaded on the exterior, screwed through the fifth ring and inner tube at right angles to the axis of the piece, and in such a position as to strike the powder chamber near the center. The lower portion is plain, and is compressed or set up into a conical recess, undercut in the wall of the chamber.

The bore, 3·74 ins., may be divided into the following portions: 1st, the rifled portion, 77 ins. long, rifled with 28 grooves, the latter being right hand and increasing; 2d, the shot chamber, 4·372 ins. by 3.82 ins; 3d, the conical part leading from shot chamber to powder chamber; 4th, the powder chamber, 12·38 ins. by 4·13 ins.; 5th, the truncated conical part of the "obturator;" 6th, the part taking the breech screw.

The breech mechanism need hardly be described in much detail. It closely resembles that of several guns recently made by the Elswick Ordnance Company. There is a screw hinged on to one side of the breech, which by means of slots cut through the threads can be entered and then turned round on its axis—which coincides with that of the bore—so that the threads enter those of the unslotted portions of the gun and engage and force home the breech piece. The general form may be seen in Fig. 1.

The "obturator" (*vide* Fig. 5) is a device for closing the

breech tightly. It consists of a greased plastic ring held between metal rings. It is forced to expand by the action of the firing charge or a mushroom head with stem passing through the center of obturator rings. It appears to act well, but to want attention.

The fore sight (*vide* Figs. 2 and 3) is termed the "Broca" sight. Its chief recommendation is that the object can be seen through the lower part of the notch if desired. In principle it is the same as the Armstrong old pattern cross-slot sight.

The projectiles are common shell, double-walled shell (see Figs. 6 and 7), and shrapnel shell. The shrapnel is of two natures, one loaded with 130 lead bullets, giving about 150 to 160 bullets and splinters, and another containing from 90 to 93 bullets, giving about 170 to 180 bullets and splinters. Each description of shell, loaded, weighs about 23·9 lbs.

The total length of the gun is 98·43 ins., caliber across lands 3·74 ins.; number of grooves 28, twist increasing from about 1 in 315 ins. to 1 in 96 ins.; thickness of walls at powder chamber, 3·81 ins.; weight of gun with B. L. apparatus, 13·79 cwts.; weight of B. L. apparatus alone, 91·93 lbs.; preponderance, 33·07 lbs.

The cartridge contains 4·63 lbs. of powder. It is 11 ins. long and 3·8 ins. in diameter See Fig. 5.

Percussion fuses of two kinds are employed—the "Buden" and "Henriot." They are scarcely worth describing in detail. Their general principle of construction resembles that of the Armstrong percussion. Indeed, the entire gun and material closely resembles the English Armstrong B. L. system, from which it differs chiefly in the relative length and diameter of the bore, and consequent proportions of projectiles, as well as in all the details.

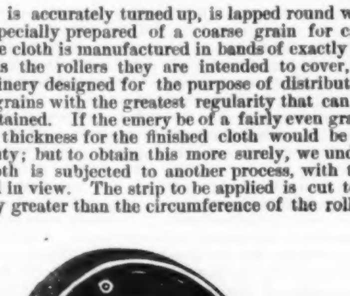
The gun carriage is of steel. There is nothing especially to notice in the fittings of it. It admits of a great range of elevation, namely from 26° elevation to 10° of depression. The initial velocity obtained from this gun is not given in the paper referred to. It is probably not far from 1,650 ft. per second. This gun may be termed a light gun of position.

The French have also a field battery gun of 9·0 centimeters—3·54 ins.—caliber; weight, 10·43 cwts.; total length, 8·2 ft.; charge, 4·4 lbs.; weight of projectile, 17·6 lbs.; muzzle velocity, 1,575 ft. per second. Lastly, there is a light horse artillery gun, 8·0 centimeters—3·15 ins.—caliber; weight, 8·64 cwt.; length, 7 ft.; charge, 3·3 lbs.; weight of projectile, 13·2 lbs.; muzzle velocity, 1,575 ft. per second.—*Engineer.*

IMPROVEMENT IN ROLLERS FOR GRINDING CARDS.

By R. J. EDWARDS & Co., London.

THE roller is accurately turned up, is lapped round with emery cloth specially prepared of a coarse grain for card grinding. The cloth is manufactured in bands of exactly the same width as the rollers they are intended to cover, by special machinery designed for the purpose of distributing the glue and grains with the greatest regularity that can be practically obtained. If the emery be of a fairly even grain, uniformity in thickness for the finished cloth would be almost a certainty; but to obtain this more surely, we understand, the cloth is subjected to another process, with this particular end in view. The strip to be applied is cut to a length slightly greater than the circumference of the roller;



its two ends are then brought together, face to face, by bending both for about an inch toward the center of the circle. A short, stout piece of wire is now passed, in the manner of a stitch, through the joined portions, and the whole is easily slipped over the roller, a slit in the rim of the latter (seen in the bottom of the engraving) receiving the joint. The spiral springs, which partly pass round the boss, are next hooked to the free or loose ends, which are, therefore, drawn through the slit until the roller is solidly, truly covered with the cloth. There is, it will readily be inferred, a spring on the other side of the roller, which our illustration, being perspective, does not show. In the way we have detailed a roller may be covered with an even grinding surface in a few minutes, against the irregular, lumpy surface obtained by nearly three days' labor with the older plan.—*Textile Manufacturer.*

AUSTRO-HUNGARIAN HIGH GRINDING.

THE BUDA-PESTH MILLS.

ON the 13th January a lecture was delivered at the German Polytechnic Institute, Prague, by Reg. Rath Professor Fr. Kick, on the Austro-Hungarian system of High Grinding.

The universal introduction of roller mills into the large mills of Pesth is a proof of their economic value. It is reckoned in Pesth that from 10 to 15 per cent. more white flour is obtained, which is equal to an increase of 80 pfennige (9½d.) per cwt. of wheat. If this statement of Adolph Fischer be compared with that of Otto Müller, according to whom 2·7 to 5·5 cwt. of wheat is ground with roller mills, for each indicated horse power, against 3·3 cwt. by millstones (showing in one case an increase, and in the other a loss of power or of its equivalent in fuel), the gain is altered in the former case to 72 pfennige (8½d.), and in the latter to 86 pfennige (10¼d.). This great variation in the amount of wheat ground by each indicated horse power, as stated by Otto Müller, is worthy of notice, and will be again referred to later on.

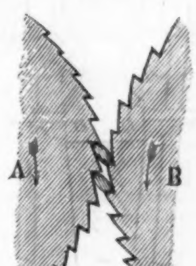
In speaking of the different kinds of rollers, without regard to the construction of the *roller mills,* Professor Kick first referred to rollers with a smooth surface, which are usually meant. Their action is mostly a squeezing one, even if the rollers are of differential speed. The action is, however, quite different when grooved rollers are used, such as those of Ganz & Co.

As may be seen by the accompanying sketch, the action of the more quickly revolving roller, A, on the grain is a cutting one. It is essential with these rollers that the roller A should revolve three times as fast as B; at least, in order to have a really cutting action, it must revolve twice as fast.

After comparing these chilled iron grooved rollers with the old grooved steel rollers, the lecturer referred to the Zipser wheat-cutting machine, the favorable results of which depend on a slight cutting action, but the speaker considered the grooved chilled iron rollers more durable than those rollers, the surface of which consists of toothed steel rings.

With regard to grooved rollers it was remarked that they are used with greater advantage in the large mills of Pesth than in small mills, because the former employ specially grooved rollers of different fineness of grooves for each crushing and for reducing the coarse bran, while small mills must make use of the same pair of rollers for every variety of work.

After a few short remarks on porcelain rollers, which were not recommended, the lecturer proceeded to investigate why roller mills require such different motive power for grinding a similar quantity of grain. He found the chief cause was the variable friction, size, and pressure of



SECTION OF ROLLERS.

the bearings. In small roller mills, as, for example, those of Wegmann, Ganz, that of Henry Haggenmacher, the small roller mill of Escher Wyss & Co., etc., this loss of power, the co-efficient of friction being only 0·06, is from 1·2 to 2·3 horse power for two pairs of rollers. In large middlings roller mills this loss of power increases to even 5-horse power for a single pair of rollers.

The necessity therefore results for the maker of such roller mills to take this into consideration in the choice of his dimensions and of the pressure, and the miller should make proper use of the screw which regulates the minimum distance of the rollers from each other, and only work with the absolute necessary pressure. The owners of small mills should therefore avoid the use of roller mills for grinding the clean middlings, as they require too much power, and should employ millstones.

The chief advantage of roller mills consists, undoubtedly, in obtaining a larger proportion of good semolina and clean middlings, but whether it is advantageous to turn the clean middlings into flour by roller mills is questionable as long as the endeavors to considerably lessen the friction are not attended with better success.

With regard to the different constructions of roller mills, the speaker remarked that these had usually no influence on the quality of the flour. The old roller mills with three pairs of rollers, one above the other, and which were designed by Salzberger, and made by the firm of Escher Wyss & Co., produce a flour fully equal to that of the more modern ones. The "Walzenmühle," in Pesth, is a proof of this statement.

No reasonable objection can be brought against the so-called reducing roller, which is itself grooved, and, working in conjunction with a grooved segment, loosens the meal. It is true that by this method the bran may be ground up; but in this case the roller and segment have been allowed to work against each other with too much pressure. The detacheur loosens the meal made by the rollers efficiently, while carelessness cannot deteriorate its work; and this is nearly its only recommendation, but it can be dispensed with in small mills. The meal coming from the rollers can be loosened by a disintegrator instead of a detacheur, but the more vigorously it is allowed to work, the more the quality of the flour will be lowered.

Professor Kick then noticed the difference in the color of flour, which had been obtained from the same clean middlings, coming from stones and rollers. It is a fact that flour made by stones is of a darker yellow shade than that made by rollers, even if the same clean middlings are used in both operations. Rollers with differential speed give a more yellow flour than those roller mills with equal speed, chilled iron rollers a more yellowish flour than porcelain rollers, and unventilated millstones a more yellow flour than those with ventilation. What is the cause of these differences? Professor Kick had heated fine yellow wheaten flour, No. 00. The temperature was carefully raised to 212 degrees Fahrenheit, the flour being contained in an evaporating pan in a hot-air bath, and on examination not the slightest difference in color could be observed, even in employing Pékar's flour test. On the temperature being raised to 316 degrees Fahrenheit, the flour lost a little of its yellow color, and became somewhat darker, but the difference in color was less than a number. The well-known brown color of the flour first appeared on the temperature being raised to 392 degrees Fahrenheit. From these experiments it follows that the above-mentioned differences in color cannot be attributed to heating during the grinding. The same wheaten flour, No. 00, on being pounded in an agate mortar in very small quantities, at a considerable pressure, showed a decidedly whiter color. We therefore see by these experiments that if all other circumstances are equal, the finer the flour the whiter the color. How do these results agree with the facts mentioned above?

If the runner of a pair of millstones at work be taken up, the furrows of the bedstone will be seen to be filled with fine flour; the grinding, therefore, takes place on a layer of fine flour and is less intense, the consequence being the production of a coarser and therefore more yellowish flour. If, however, the flour be blown out by ventilation the stones grind more effectively, the "dead" flour is got rid of to some extent, and finer and therefore whiter flour is obtained. Flour made by rollers can only be whiter than that made by stones by the finer grinding qualities of the former, and being better freed from the flocculent particles of the middlings. Of course it is understood that the flour is in both cases made from middlings of the same degree of purity. It is evident that, under the same circumstances, the rough porcelain roller gives a whiter flour than the smooth chilled iron rollers. It is a seeming contradiction that rollers with differential speed should yield a more yellow flour than those without this arrangement. This contradiction is, however, explained if it be taken into consideration that rollers, with equal speed, work also with a greater pressure. The particles of grain are subjected to a greater pressure, and in consequence the flour is finer and therefore whiter.

In passing the middlings through the rollers small flakes of flour and soft middlings are obtained, which are reduced by the detacheur, and it is therefore probably only necessary to employ less fine sieves for the flour cylinders in order to obtain a coarse yellow flour similar to that made by stones in grinding middlings.

The lecturer then referred to centrifugal silk dressing machines, which he had seen in use in some mills of Pesth, and they were liked for dressing soft middlings—the chief advantages of these machines being the small amount of space they took up—passing on to the new semolina purifiers, especially those made by C. Haggenmacher, which were described as excellent, and were being employed in many large mills of Pesth.

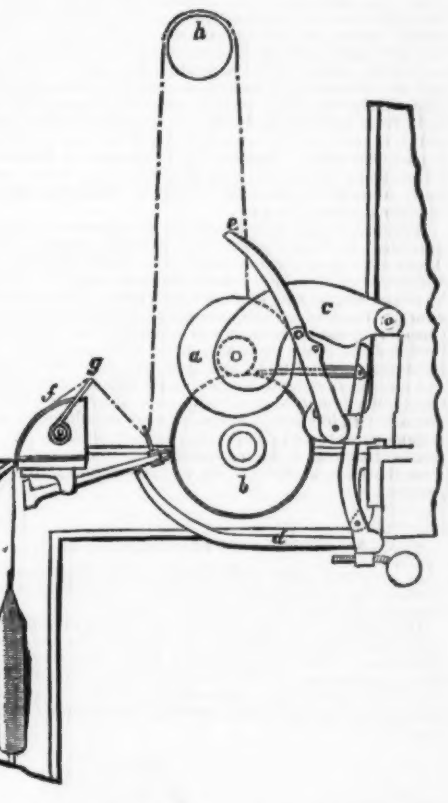
In conclusion, Pékar's flour test was referred to and illustrated by an experiment.—*The Miller.*

J. & T. BOYD'S DOUBLING WINDING MACHINES.

WE are informed that at the present time no one can be said to have more completely succeeded in the doubling winding process than Messrs. J. & T. Boyd, of the Shettleston Iron Works, Glasgow, whose machine is the subject of this notice, and who claim to have been the first to introduce various practically useful and successful novelties.

Some idea of the estimation in which these machines are held may be formed when we state that so far back as February, 1876, Messrs. J. & P. Coats of Ferguslie Thread Works, Paisley, had 5,000 drums in operation, and have since ordered 3,500 drums in addition. Messrs. Clark & Co., of the Anchor Thread Works, Paisley, have in use or ordered 3,880 drums; and the machines have also been introduced in many other works both in Scotland and England and abroad, in all cases giving great satisfaction.

In giving an idea of the special features of Messrs. Boyd's machine, it is unavoidable that we should refer to some well-known parts, as it is very rarely, if ever, that a new machine



to effect a well-known operation successfully can be altogether different from its predecessors. The best new machines are those which, retaining features of previous ones, the value of which has been established by lengthened trial and use, improve upon them in parts and functions which have not been quite as perfect as could be wished, or add details enabling them to do what could never be satisfactorily done before.

It seems to be quite settled that the best main winding arrangement for doubling purposes is that in which a continuously revolving drum or pulley, on a horizontal shaft, is in contact with the bobbin, or rather with the yarn or thread that is being wound on the bobbin. This insures a uniform winding speed, notwithstanding the increasing diameter of the wound yarn, and it admits of the motion being instantly stopped, as far as the bobbin is concerned, on simply moving it away from the drum, without stopping the motion of the drum. In Messrs. Boyd's machine each bobbin, *a* (see cut), when winding, rests on a revolving drum, *b*, being held in a peculiar lever frame, *c*, hinged to the fixed framing, and which can turn so as to lift the bobbin off the drum, through the action of a slip lever, that is itself made to act by means of detecters, to be afterward described. The slip lever carries a thin slip of millboard, or metal, which, on the stopping action being called into play, moves in between the drum and the bobbin, and the motion of the drum drawing it further in, it interposes itself so as to completely separate the drum and bobbin, and instantly stop the driving action on the latter. Almost simultaneously with this action the bobbin is lifted up quite clear of the drum.

Messrs. Boyd employ various detecter arrangements in their different machines, and in their latest, which is adapted for extremely light yarns, there is combined a novel and happy deviation from the ordinary traversing guides, moving slowly from side to side to distribute and lay the yarns evenly from end to end of the bobbin. In this arrangement the two or

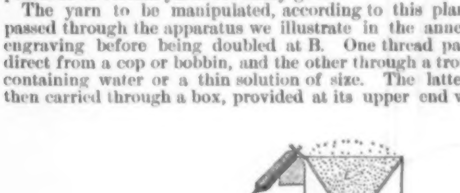
more yarn ends of the set that are wound on one bobbin are led through eyes at the inner ends of separate detecter levers, centered under a rail near the front of the machine. From these detecter levers the ends are led up to a roller, or pulley, carried at a certain height above the bobbin by an arm fixed to a central traverse bar, which serves for both sides of the machine, and has the usual traverse motion imparted to it. From the roller or pulley carried by the traverse-bar the ends descend to the bobbin, which rotates as is shown by the arrows. The roller thus serves as a guide by which the traverse motion is imparted to the ends; also for giving a sufficient length of course to the ends between the detecter levers and the bobbin; also for preventing a broken end from becoming entangled on the bobbin; and also for causing a stronger end or ends of a set to assist a weaker end or ends, while the entire arrangement causes the strains due to the winding operation to act, so that a weak end is more likely to break at such a distance from the bobbin that the automatic stoppage can be effected with certainty before the broken end reaches the bobbin. It is not often that a modification, like the one just referred to, has so many advantageous features to recommend it. Each yarn, when unbroken, holds up its detecter lever, but on the end breaking or failing the lever falls, and its descent is hastened by the drum, in consequence of a piece of rubber, fixed on its inner end, coming in contact with the drum. The quickness and certainty of action of this contrivance—got at in the simplest and most direct manner, without roundabout and complicated additions—must be seen to be adequately appreciated. The detecter lever, in descending, comes into contact with a cross wire fixed to a curved arm, *d*, which extends from the slip lever, already referred to, under the drum and toward the front of the machine, and thereby brings about the stoppage of the rotation of the bobbin. When an end breaks and causes the automatic stoppage of the bobbin, the worker moves back a hand lever, *e*, which causes the bobbin to be lifted a little further from the drum, so that it can be more conveniently got at, and at the same time moves back the slip lever, causing the cross wire on its forward arm to raise all the detecter levers up into their acting positions, so that the yarns can be easily threaded through their eyes, and, in doing so, the slip lever also lifts a separate lever or loose piece, which, on the hand lever being afterward drawn forward to restart the winding action, bears down the forward arm of the slip lever so as to be quite free from the detecter levers, but only to a short distance determined by a stop. The roller on the traverse bar is covered with vulcanized rubber, which prevents loose ends or snarls from springing forward; and a kind of open casing is arranged to partially inclose the roller, and is formed with a slit, by which the ends are entered when being placed on the roller, and which guides them into their proper position thereon, and keeps them from getting displaced. A separate curved friction-bed, *f*, covered with flannel, is provided for each set of yarns to pass over before entering the guide-eyes of the detecter levers, and is fitted with a small guide-rail, *g*, which can be easily adjusted, to vary the extent of contact of the yarns with the frictional surface.

With the simple and ingenious arrangements which we have described the bobbin stops instantly when a yarn or thread breaks or fails, *leaving from 12 to 18 inches of the broken end off the bobbin*, which allows the separate strands to be pieced singly, and renders bunch knots altogether unnecessary. The parts of the machine are really few and simple, considering the many functions performed and contingencies provided for. All parts are made interchangeable, being finished by special tools, and they are easily oiled, cleaned, and put together; and Messrs. Boyd claim for the machine that, while it stands on a small space, it gives a better production with less waste, is always more certain in its action, is more convenient to work, is easily adjusted, the same adjustment making it do for winding any number of strands, from the coarsest numbers up to 250's cop.—*Textile Manufacturer.*

MACHINE FOR FLOCKING YARN.

Le Jacquard gives a description of an apparatus which, though crude, is intended to produce a new effect in the appearance of certain yarns for fancy goods.

The yarn to be manipulated, according to this plan, is passed through the apparatus we illustrate in the annexed engraving before being doubled at B. One thread passes direct from a cop or bobbin, and the other through a trough containing water or a thin solution of size. The latter is then carried through a box, provided at its upper end with



a hopper filled with particles of colored wool, broken fiber from rag-ends, feathers, or any desirable substances, which are allowed to fall through an opening at the bottom of the hopper, and upon a revolving fan-wheel, C, which pulls it out and disperses it, throwing it upon the thread passing through the lower part of the box at A.

In a modification of this arrangement a traveling apron runs under the threads, and carries any superfluous flocks or feathers back into the hopper. In this manner any foreign substance may be evenly or intermittently twisted into the yarn.

TEXARKANA.

The city of Texarkana is built at the junction of Texas, Arkansas, and Louisiana. It received its name in 1819, when an enthusiastic surveyor, while running the lines, blazed the three fragments of the names of the new States on a tree, and predicted that a great city would be built there. Three years ago, when the town was founded, the name, still to be seen on the old tree, was adopted, and the prediction seems in a fair way to be verified, as the town now has 3,000 inhabitants, and is an important railroad crossing.

REVOLVING BOX FOR LOOMS.

M. Mounier has, according to *Le Jacquard*, invented an arrangement that seems to contain a novelty as to the cards and hoops worked by them. The novelty consists in the fact that the holes in the cards are not, as usual, of one size, but of three different sizes (see Fig. 2); the hooks or rods

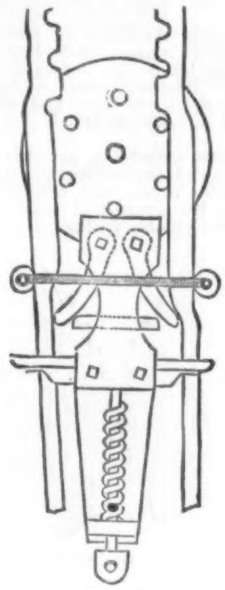


Fig. 1.

worked by the cards are also pointed in three different thicknesses to correspond with these holes. It will be observed, also, from the illustration, that, in proportion as these rods penetrate more or less through the holes, they traverse a longer or shorter distance, and in this way turn, through the

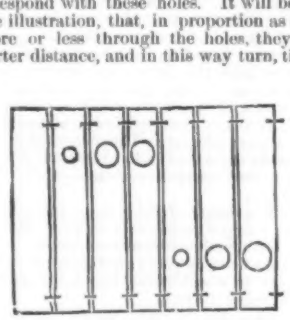


Fig. 2.

notches corresponding with the pins on the box, the latter a greater or shorter distance round either way. The arrangement is so plain from the drawing that we need not enlarge upon it any further. Still, without seeing the contrivance in action, it would be difficult to express an opinion as to its value.

JUTE.

Mr. E. Pfuhl, formerly manager of a spinning mill, but now teacher in an industrial school in Prussia, recently contributed to *Dingler's Journal* the first part of a treatise on jute spinning:

Jute Fiber.—Of all foreign fibers jute is, perhaps with the exception of cotton, the one used in largest quantities, although its introduction into Europe dates back but little more than forty years. The home of the plant (*Corchorus capsularis* and *Corchorus olitorius*) is India, but lately it has also been naturalized and cultivated on a considerable scale in Algeria, French Guinea, Mauritius, and the Southern States of America. The Hindoos have for years made both ropes and cloth of it, but in Europe it has principally been used for baggings, tarpaulings, sackings, and hessians. Latterly its application has been much extended, for, as it easily bleaches and may be dyed with some degree of perfection, it is now used for carpets, table-cloths, curtains, and many other articles of luxury, besides being "smuggled" into other textiles, such as silk and linen, by way of adulteration.

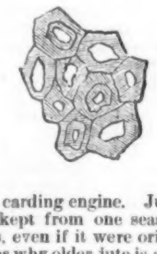
The waste obtained in spinning jute is used as stuffing for upholstery and as cleaning waste, and the shortest of all, the waste of the waste, and which is inapplicable for the manufacture of paper, makes an excellent manure, so that nothing is lost. As a competitor with flax it may even be of advantage, for, being more useful than the common qualities of the latter, its application will tend to force the flax culture into the finer qualities where this material is unrivaled.

The jute plant is an annual, being sown in April and May, and maturing in about 100 days, at which age it generally attains a height of about 12 feet, and a thickness of ½ inch. The fiber is situated between the stem and the bass or skin, and is extracted by a process of retting similar to that employed for flax. The raw fiber so obtained is sent in bulk to Calcutta, where it is sorted and classified by dealers according to its fineness, color, etc., and afterward brought into the market. On account of the length of the fiber it is doubled up when packed, and then tightly pressed to economize space and also to prevent it from getting damp. It was once considered that jute could not withstand much dampness, and that it rots when exposed to moisture, but experience has shown that this is erroneous. It varies very much in color, gloss, fineness, softness, firmness, evenness, cleanliness, and length, and in the arts it is used for different purposes, according to these qualities.

The best qualities are pale yellow and silver gray, with a very perceptible gloss, and are very divisible. The root end is generally darker in color, less glossy, and the bundles are thicker at this part; the fibers are also blunt from being cut; the upper portions are thinner, and the fibers terminate in finer points. The very best qualities show little difference between the lower and upper ends. Jute fiber is so far different from flax and hemp, as the bass, as a rule, does not adhere to it, and it therefore generally comes in a cleaner condition to the market than these latter textiles.

A plant growing to a height of twelve feet yields fiber of from seven to nine feet long, and taller plants have furnished fibers up to fourteen feet long. It is a mistake to judge the quality of jute from the length of the fiber, for often the longer sorts are devoid of gloss, the absence of which is generally a sign of want of firmness and strength. The medium qualities are mostly of a brown and dark shade, the lower qualities inclining to reddish and brown hues, and are frequently very uneven. The lower, or root end, mostly assumes a reddish-brown color, and is often hard and coarse, while the upper portions are curled and also hard, and very similar, the parts between being soft and fine, and adapted for spinning the higher numbers. In such cases it is advisable to cut the two ends off, in order to obtain a more uniform fiber.

Where small hard particles of bass adhere to the fiber (no matter how high its quality), it is useless spinning it for warp yarn, because these particles cannot well be removed,



certainly not by the carding engine. Jute loses in gloss and firmness by being kept from one season into the next in closely packed bales, even if it were originally of a superior quality; this explains why older jute is always lower in price than fresh arrivals. The bundles in one bale are sometimes not of the same color or quality, though sold as such, and after opening they should therefore be carefully examined and sorted, and if any bundles have by accident been wetted they should be well dried before taken into the mill.

The fiber has a slight and not disagreeable odor, but the yarn spun from it smells stronger on account of the seal oil which is used in the process of spinning. When petroleum is used for softening the fiber the odor is still stronger and disagreeable, and for flour sacks very objectionable; such yarn should be exposed to the air for some time, by which means the smell is removed.

Jute fiber has a much greater disposition to undergo the ligneous change, and to darken with age like wood, than either flax or hemp; this has been proved by Professor Wiesner. He found that while damping with sulphate of aniline turns the jute into a deep golden color, hemp gets only a pale yellow, and flax is scarcely affected.

To distinguish jute from flax and hemp this test is sufficient, but other fibers are sometimes sold as jute which in this respect have similar properties; to determine them it is necessary to resort to the microscope. Here it will be observed that the fiber of jute is not, like that of other kinds, one hollow tube, but an agglomeration of several uneven tubes or longitudinal cells, not closely connected, and sometimes with air spaces between them. Unlike the fibers of flax or hemp the sections of different fibers are very uneven, and moreover the inner contour of the cell does not follow the outline of the outer surface, so that the tube is of varying thickness, as is clearly shown in the accompanying diagram.

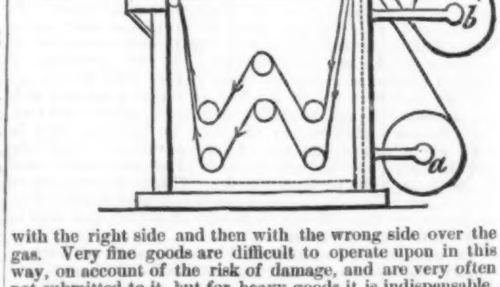
Jute can withstand dampness much better than has been commonly supposed; trials made with the object of testing this point have proved that cloth made with a mixture of flax and jute, when exposed for some time to the action of water under different temperatures, has suffered more in the flax than the jute threads; the fact that jute is used as a covering for submarine cables proves also its resistance to the action of water.

Like all textile fibers, jute is to some extent hygroscopic; thus the place of storage has a great influence upon the weight of the fiber or yarn made from it. Both are, however, not hygroscopic in the same degree, for experiment shows that yarn stored in damp places attracts more water than the unworked fiber. That this property opens a loophole for dishonesty scarcely needs pointing out.

BLEACHING OF WOOLEN GOODS.

The art of bleaching woolen goods has not progressed at the same rate as that of cotton goods during the last twenty years, and we do not remember having seen in any work a detailed description of the process as mostly practiced. A short review of the same and the latest improvements will, therefore, not be out of place.

The first operation is the singeing, mostly done by gas, the pieces, generally of a length of 72 yards, passing first



with the right side and then with the wrong side over the gas. Very fine goods are difficult to operate upon in this way, on account of the risk of damage, and are very often not submitted to it, but for heavy goods it is indispensable. In order to prevent the dust from proceeding with it, the cloth is passed through cold water in the same way as in the succeeding operations of bleaching.

For this latter process five pieces are generally sewn together, and submitted to a first action of soaping. The lye for this is often composed of about 24 lbs. of soft soap, 13 lbs. soda crystals, and 70 gallons of water heated to about

50° Centigrade. This bath is placed in a vat, arranged as is shown in Fig. 1, so that two rolls of five pieces pass simultaneously through it from rollers. The vat we illustrate is about three feet long, forty inches wide, and three feet high, and is heated by steam passing into it; the passage of one pair of rolls occupies about thirteen minutes, and is repeated three times. After the passage of each pair of rolls 5 lbs. of soft soap and 3 lbs. of crystals of soda are added, and as much water as has been lost. When thirty pairs of rolls have been passed the liquor is run off.

After this first soaping the cloth is passed twice through a hot-water bath heated to about 50° Centigrade, the water being renewed after each double passage; it is then submitted to a second soaping, identical with the first, but only containing 11 lbs. soda, while ¾ lb. is added after each double passage.

The cloth is now washed four times in water heated to 50° Centigrade; the first pair of rolls is washed in pure water, which is then run off and renewed; the rolls run through this twice, when it also is changed, so that the fourth and last washing takes place in pure water. The water of this last bath serves, however, for the first passage of the next pair of rolls.

The succeeding operation is the passing through soda. For this 24 lbs. of crystals are dissolved in 55 gallons of water heated to 50° Cent. The cloth is sent through only once, and only one roll at a time is operated upon, so that any spots may be discovered and removed at once with a little soap. In order to keep up the strength of the bath 3 lbs. of soda are added after the passage of 10 pieces, and the whole renewed when 300 pieces have gone through.

Where two vats are used for the soaping, two for the washing, and one for the soda, or five in all, 90 to 100 pieces can be bleached in a day. This proceeding is, however, costly, on account of the great loss of time and steam, and the enormous quantity of liquid required. To avoid this waste several machines have been invented to effect the same purpose, and the machine constructed by the Zittau Machine Works, and which was exhibited at Vienna in 1873, has undoubtedly many features to recommend it.—*Textile Manufacturer*.

TREATMENT OF WOOL ON THE SKIN.

WE notice in an exchange a very interesting account of a new method of treating wool on the skin as invented by Messrs. Puech of Mazamet, and which in practice has the reputation of giving excellent results. The dry skins, as coming from America or the colonies, are by the new process treated in two hours instead of a whole week, as formerly, while for skins from fresh-slaughtered animals a few minutes suffice. The proceeding adopted is as follows, viz.:

1. To an ordinary bath of 45° to 50° Centigrade is added any substance which destroys fat, such as soda, soda crystals, soap, etc.; in this the dry skins are soaked for about eight or ten minutes, while three or four minutes are sufficient for fresh ones.

2. The skins are then immediately passed through squeezing rollers, which have sufficient pressure to remove the sweat, grease, and dung, and other impurities which may be in the wool.

3. This completed, and for as long as the skins remain warm, they are passed through a machine in which they are beaten under a shower of tepid water, with the object of abstracting all impurities not removed by the preceding squeezing process.

4. For a period of ten minutes the skins are next soaked in tepid water, in order to be rendered perfectly soft and in a fit condition for removing the wool.

5. In this operation the skins are passed through heavy squeezing rollers, and while leaving them are beaten or shaken so that the staple of the wool is risèd and made to flock to a greater extent.

6. While the skin is still a little warm any substance which has the property of loosening the wool is applied to the fleshy side with a brush.

7. The wool is then taken off the skin and the latter dried for the market.

Wool thus obtained is called "flocked wool" by the inventor, and several advantages are claimed for it, such as the following: If during the foregoing operations care has been taken not to let the wool dry, but to keep it in a moist condition, it may at once be taken to the carding engine. As the washing and cleansing of the wool is done while the latter is on the skin, the usual operations preparatory to carding are not required; the fleece is completely clean, and not matted, and at once ready to be carded, and as this carding immediately succeeds the stripping, there is little waste. It is further asserted that the wool is of a superior quality, clean, and better ready for the carding engine, because in being removed from the skin it undergoes an operation analogous to combing.

In order to obtain what is termed shorn wool, the forementioned operations are followed by a washing in a so-called leviathan washing machine, being subject to a thorough squeezing afterward.—*Textile Manufacturer*.

"WEIGHTING."

AMONG the many improvements effected in this age of progress not the smallest is the art of sinning by the hands of others, while we reap the benefit of the questionable transaction, and, in our own opinion, escape all responsibility. This stratagem is practiced with success in various spheres of life. We not unfrequently see some wealthy and influential philanthropist, great at "conferences," and dealing largely in benevolence, wholesale and for exportation, who yet commits, through the instrumentality of some unfortunate manager or private secretary, the meanest and most unjust actions, shaving, so to speak, along the very edge of the law. But the world does not, in the words of the old adage, put the saddle on the right horse. If such scandalous affairs are spoken of at all, it says apologetically that the great and good man is unable to look with his own eyes into every department of his extensive and varied concerns, public and private, and has been unfaithfully served by his subordinates. Sometimes it actually happens that the law has been openly infringed. But then it always turns out that some agent is—technically, at least—the responsible party, and our philanthropist quietly sails on with unspotted plumage. To come more directly to the point, the public is now scandalously robbed by dyers, though not for their own benefit or pleasure. The manufacturer uses them as a tool to pick the pockets of his customers. Every one knows that silk, in the process of ungumming, loses a very considerable portion of its weight, which may even exceed 25 per cent. The manufacturer, annoyed at thus losing a portion of a valuable article, began to stipulate that the dyer should, in spite of this natural and inevitable loss, return him the same weight of dyed silk as he had received in the raw state. To do this the dyer was compelled to plaster, so to speak, upon the fiber matters not really requisite for dyeing, but which should make the fiber heavier. Appetite grows by what it feeds upon, and when a depraved and perverted ingenuity had succeeded in bringing up the weight of the silk to what it had been before ungumming, the process did not stop. The manufacturer who sent 100 lbs. of silk to the dyer came gradually, in some extreme cases, to receive back 150 lbs. of an article which was not, indeed, silk, but which could be called silk, and sold as such. For the outside public the great disadvantage remained that the weighting materials have none of the physical and chemical properties of genuine silk, for which it is valued. Silk is an exceedingly strong, dense, elastic fiber, a very poor conductor of heat and electricity, and unaffected by air and moisture, even on prolonged exposure. Hence it is capable of resisting great wear and tear; it is unaffected by atmospheric changes, and thickness for thickness proves "warmer" than any other textile material. But the materials used for weighting, whether gums, sugars, salts of lead, compounds of oxide of iron, with astringents and the like, are in these respects strikingly dissimilar. In their physical and chemical properties they do not resemble real silk. Weighted silk is weak, inelastic, brittle, yielding rapidly to friction. It readily absorbs damp, and instead of resisting the action of the atmosphere, when heaped together in large quantities it is capable of heating, like ill-made hay, and of actual spontaneous combustion. Genuine, natural silk will scarcely burn if laid upon a fire; weighted silks, in the yarn at least, will burn spontaneously. When ladies complain that their silk dresses wear out with surprising and unaccountable rapidity, scarcely outlasting those of humble cotton, and being utterly incapable of undergoing those mysterious processes of "turning" which our mothers and grandmothers used to practice; when our best umbrella, warranted to be of "pure Italian silk," begins to split down each segment after six months' very careful usage, we see in all this the consequences of weighting.

But silk is not the only fiber which undergoes fraudulent treatment. There is an old West Riding joke of mixed goods in which the wool was all cotton, and the cotton all jute. But cotton and jute, if inferior in value to wool, are at any rate textile fibers. But we are now in danger of wearing, or at any rate of buying tissues where the cotton is all Cornish clay, and the wool all chloride of magnesium. The latter salt is now imported in abundance from Germany, where it is obtained as one of the products of the great salt beds of Stassfurt, and is sold under the name of "crystal size." It is a remarkable fact that sophisticating manufacturers, merchants and tradesmen, just like burglars and pickpockets, have always some slang name for the articles they employ in their underhand operations. They shrink from calling a spade a spade, fearing, perhaps, lest the public should call a knave a knave. Thus bakers speak of the potatoes which they legally, though not equitably, mix with their ware as "fruit." Then we have such other expressions as "stuff," "hards," "multum," "the doctor," and many more. Whether we are to regard the use of such language as part of the tribute which vice is said to pay virtue we leave an open question. But whether we are to call chloride of magnesium by its own name, or by that of "crystal size," its properties are the same, and these we must now consider. It is, in the first place, exceedingly soluble in water, so that its solution weighs upward of 20 lbs. to the gallon. It, further, has little or no action upon coloring matters, so that if applied to dyed goods it does not betray itself by spots and stains. These properties are just what the sophisticating manufacturer wants. But it is not merely soluble, but deliquescent. It constantly draws more moisture out of the atmosphere. Hence no textile fabric which has once been treated with this liquid can ever be made thoroughly dry till every trace of the weighting has been washed out. Now, as blankets, flannels, etc., are often put to use without a previous washing, it follows that many persons unwittingly encounter the perils of damp beds, underclothing, and the like. How many cases of rheumatism, cough, consumption, and other diseases, if not directly caused by this modern commercial iniquity, are aggravated by it would not be easy to ascertain. There is something particularly villainous in a practice which thus converts the very precautions we take to preserve our health into causes of disease and death. But people should wash their blankets, flannels, etc., before taking them into use. But how are they to do it, so as to remove this iniquity? The only effectual way—prolonged steeping in a succession of waters—is what no housewife will care to adopt, because it makes the goods shrink. And if such flannels are washed with hot soap lye in the customary manner, the chloride of magnesium will decompose the soap, forming a "magnesian soap," and coating every fiber with a smeary layer, scarcely ever to be removed without using soda to a most injurious extent. The law punishes—leniently, indeed—the baker, grocer, or publican who sells to the public a debased article. If he knowingly uses adulterants injurious to health the penalty is more severe. If we remember rightly, an extensive corn merchant in Glasgow once received the award of six months' imprisonment for having mixed barley meal among the oatmeal supplied to a hospital. But, of the two, we think that invalids would suffer less from gruel made of barley meal. Will no statesman propose imprisonment as a cure for chloride of magnesia? We have been told that the old and fast-vanishing fame of our English woolen trade was in no small degree due to the fact that one of our earlier kings did, in all solemn sadness, hang such as made "evil cloth."—*Chemical Review*.

OF THE BURLS IN WOOL.

THIS process, invented by M. Joly, of Elbeuf, offers striking advantages in comparison with the use of sulphuric or hydrochloric acid. The colors are not attacked, and there is no reason to fear acid spots. The wool is first saturated with a solution of chloride of aluminum at 6° or 7° Baumé. It is drained in a centrifugal, dried, and kept for three-quarters of an hour in a chamber heated to 212° to 257°. It is finally washed with water to remove the chloride of magnesium.—*Deutsche Wollengewerbe*.

WEIGHTING TISSUES WITH CHLORIDE OF MAGNESIUM.

COTTON goods are now more and more weighted with this salt. Certain shirtings lose on washing from 15 to 45 per cent. of their original weight. The chloride of magnesium is sold for this purpose sometimes openly under its own name, and sometimes as "crystal size." Sulphate of magnesia (Epsom salt) is also used for the same purpose.

At Lyons, during the past year, there was offered to silk dyers an article, the composition of which was made a mystery, but which was simply the chloride of magnesium. Silks steeped in this solution, after dyeing, increased in weight from 15 to 20 per cent., but the handle was impaired, and the goods became hygrometric. We do not believe that this article has been adopted for weighting purposes in the silk trade.

Unfortunately silks are always weighted with sugar, and this detestable custom, far from diminishing, increases more and more.

The use of oxymuriate of tin in concentrated solutions at 25° Baumé, for weighting colored silks, is very much restricted by the fact that it affects certain colors. On the other hand, weighting with sumac and galls, which does not injure the fiber, is extending. Organzines are thus weighted to 10 to 15 per cent., and "souples" to 40 to 60.—*Moniteur Scientifique*.

NEW SYSTEM OF CONTRACTIONS FOR GERMAN WEIGHTS AND MEASURES.

AT the end of last year, the German Federal Council issued a list of contractions which are hereafter to be used in all official documents to indicate the respective weights and measures in use in Germany. The following table will be found very useful, and its preservation will do away with a great deal of the annoyance that is often occasioned by the necessity of looking up such matters in various books. The new system has been introduced in the *Chemisches Central-Blatt*, and the example of this paper will be followed by all other scientific papers, if it has not been already:

Kilometer........	km	Cubic meter.........	cbm
Meter	m	Hectoliter...........	hl
Centimeter.......	cm	Liter	l
Millimeter	mm	Cubic centimeter....	ccm
Square kilometer.	qkm	" millimeter....	cmm
Hectare..........	ha	Tonne...............	t
Are..............	a	Kilogramme	kg
Square meter.....	qm	Gramme..............	g
" centimeter.	qcm	Milligramme.........	mg
" millimeter.	qmm		

No stops follow the letters; and the latter are placed after the figures which express the amount, not over the decimal point; thus, 5.37m, not 5m 37cm. In separating the integral numbers from those representing a decimal part, a comma is employed instead of a period. The comma is not to be otherwise used when writing numbers representing measures of weight or capacity, nor as formerly to divide high integral numbers; in such cases the digits are to be divided into groups of three, counting from the comma (our decimal point), and the division between the groups is to be marked by space.

THE UNCONSIDERED USES OF TIMBER.

IT is usual to refer the consumption of wood to such causes as the demand for building and engineering purposes, and also such minor ones as the lucifer match and road-making industries make. It is true that these are the principal means by which wood is consumed in this and other countries, but there are countless other ways which go to swell the sum total in no insignificant degree, and yet which are left in comparative obscurity, for few persons think of them. As, for instance, in America tulip-wood is much used for wooden bowls, and for the heads of hair brooms or sweeping brushes, for eating and drinking troughs of cattle, and no inconsiderable portion furnishes wood for Indian canoes. One of the principal uses of the holly, dyed black, is to be substituted for ebony, in the handles of teapots, etc., and the strong, straight shoots, deprived of their bark, are made into whip-handles and walking-sticks. The lime tree forms the best planks for shoemakers and glovers upon which to cut their leather, and is extensively used in the manufacture of toys and Tunbridge ware, and by the turner for pill-boxes, etc., and the inner bark is made into ropes and matting. The sycamore furnishes wood for cheese and cider presses, mangles, etc., and when the wooden dishes and spoons were in common use they were mostly made of this wood. It is used now in printing and bleaching works, for beetling beams, and in cast-iron foundries for making patterns. The yew is used by the turner, and made into vases, snuff-boxes, and musical instruments, and it is a common saying among the inhabitants of New Forest that "a post of yew will outlast a post of iron." Where it is found in sufficient quantities to be employed for works under ground, such as water-pipes, pumps, etc., the yew will last longer than any other wood. Gate posts and stakes of yew are admirable in wear, and in France the wood makes the strongest of all wooden axle-trees. Of the beech are made planes, screws, wooden shovels, and common fowling-pieces and muskets are also stocked with it, and beech staves for herring barrels are not unknown. The sweet or Spanish chestnut furnishes gate and other posts, railing and barrel staves, hop-poles, and other such matters, as strong and good charcoal, though scarcely equal to that of oak for domestic purposes, but considered superior to that of any other for forges, for which purpose it is much used in Spain, and also in Switzerland. Horn-beam is the best wood that can be used for cogs of wheels, excelling either the crab or the yew, but its application in this manner is about at an end. As a fuel it stands in the highest rank, emitting much heat, burning long, and with a bright, clear flame. In charcoal it is also highly prized, not only for culinary purposes and the forge, but also for the manufacture of gunpowder, into which, on the Continent, it enters in large proportion. In Russia, many of the roads are formed of the trunks of the Scotch pine, trees from six inches to a foot in diameter at the larger end being selected for the purpose. These are laid down side by side across the intended road, the thick end of one alternating with the narrow end of the other, the branches being left at the end to form a sort of hedge on each side of the road. When thus laid the hollows are filled up with earth, and the road is finished, being analogous to the corduroy roads of North America. In Germany, casks are made of larch, which is almost indestructible, and allows of no evaporation of the spirituous particles of the wine contained in them. In Switzerland it is much used for wine props, which are never taken up, and which see crop after crop of vines spring up, bear their fruit, and perish at their feet, without showing symptoms of decay. The uninjured state in which it remains when buried in the earth or immersed in water renders it an excellent material for water-pipes, to which purpose it is largely applied in many parts of France. The butternut is esteemed for the posts and rails of rural fences in America, for troughs for the use of cattle, for corn shovels, and wooden dishes. Shell-bark

hickory provides baskets, whip-handles, and the backbows of Windsor chairs. The pignut hickory is preferred to any other for axle-trees and ax-handles. The sugar-maple is used by wheelwrights for axle-trees and spokes, and for lining the runners of common sleds. Dogwood is used for the handles of light tools, such as mallets, small vises, etc. In the country it furnishes harrow teeth to the American farmer, and supplies the hames of horses' collars, etc., also lining for the runners of sledges. The mountain laurel is selected for the handles of light tools, for small screws, boxes, etc. It most resembles boxwood, and is most proper to supply its place. Bowls and trays are made of red birch, and when saplings of hickory or white oak are not to be found, hoops, particularly those of rice casks, are made of the young stocks and of branches not exceeding one inch in diameter. Its twigs are exclusively chosen for the brooms with which the streets and courtyards are swept. The twigs of the other species of birch, being less supple and more brittle, are not proper for this use. Shoe lasts are made from black birch, but they are less esteemed than those of beech. Immense quantities of wooden shoes are made in France from the wood of the common European alder, which are seasoned by fire before they are sold. The wood of the locust is substituted for box by the turners in many species of light work, such as salt-cellars, sugar-bowls, candlesticks, spoons and forks for salad, boxes, and many other trifling objects, which are carefully wrought into pleasant shapes and sold at low prices. The olive is used to form light ornamental articles, such as dressing cases, tobacco-boxes, etc. The wood of the roots, which is more agreeably marbled, is preferred, and for inlaying it is invaluable. Of persimmon turners make large screws, and tinmen mallets. Also shoemakers' lasts are made of it equal to beech, and for the shafts of chaises it has been found preferable to ash, and to every species of wood except lance-wood. The common European elm is used for the carriages of cannon, and for the gunwale, the blocks, etc., of ships. It is everywhere preferred by wheelwrights for the naves and fellies of wheels, and for other objects. White cedar serves many subsidiary purposes. From it are fabricated pails, wash-tubs, and churns of different forms. The ware is cheap, light and neatly made, and instead of becoming dull, like that of other wood, it grows whiter and smoother by use. The hoops are made of young cedars stripped of the bark, and split into two parts. The wood also supplies good charcoal. The red cedar furnishes staves, stopcocks, stakes, and is also used for coffins.

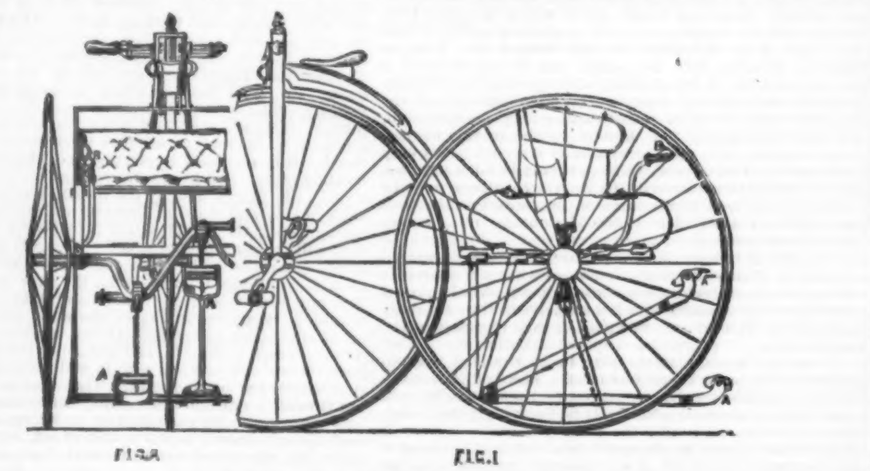
A few others may be briefly named, separating into trades as follows, applying to the American manufacture:

Sieves, usually of black or water ash for the bottom, and oak or hickory for the circle; whip-stocks, white oak and shell-bark hickory; picture-frames, white pine and sweet gum; saddle trees, red maple and sugar maple; screws of bookbinders' presses, hickory and dogwood; hatters' blocks, corn shovels, butternut; shoe lasts, beech and black or yellow birch, etc.

This slight sketch, which is by no means complete, will serve to give an idea of some of the ways in which timber is consumed, besides being wasted and put to its legitimate purposes in other manners. The items may seem beneath notice, but the aggregate must be something important.—*London Timber Trades Journal.*

STRANGE'S TRICYCLE.

The chief object of the inventor of this tricycle is stated in his patent specification to be the arrangement by which a woman is enabled to ride and assist in propulsion. The front wheel is similar to that of a bicycle, the bearings of the axle being mounted in a fork furnished with a steering handle, the socket of the fork being connected by a backbone of the



IMPROVED TRICYCLE.

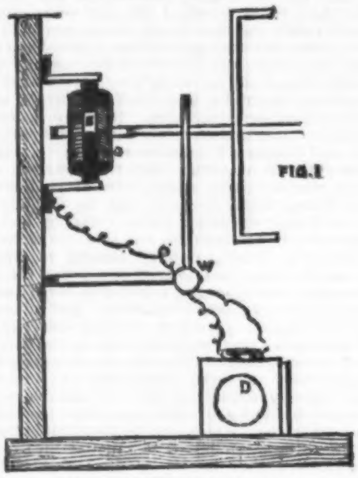
usual kind with the rear part of the frame carrying the bearings in which the action of the two hind wheels revolves. One wheel is fixed on the axle and the other runs loose to admit of turning curves. On that part of the axle which is between the wheels are formed twc cranks, which are connected by chains with two-foot levers, A, of the second order, jointed to the frame. Over these cranks is a seat for the person who drives them by depressing the levers with his or her feet, the seat being suspended or mounted on springs with its back toward the fore part of the tricycle, so that the rider, with the assistance of the handles, B, can easily get into or out of the seat from the rear. The rider on the fore part of the tricycle drives the fore wheel and steers the tricycle, while the rider on the rear part simply works the foot-levers which drive the hind wheels. The tricycle is furnished with a suitable brake.

On a good road the inventor and a companion have, it is said, been able to maintain a speed of from ten to twelve miles an hour upon a fair journey.

Artificial Coloring Matters Fixed by means of Sulphur.—By M. Vaucher.—The author finds that wool boiled in a solution of sodic hyposulphite in presence of sulphuric acid not merely attracts aniline-green, but gives fuller and brighter shades, with a number of artificial colors, among which are mentioned eosin, aniline-brown, phosphine, safranin, aniline-violet, etc.

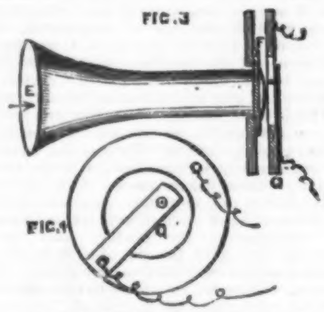
THE PHONOSCOPE AND THE PHONEIDOSCOPE.

The first is the phonoscope, in which Mr. Henry Edmonds, Jr., has produced a beautiful instrument for showing the action of sound, when the sound waves act upon a revolving vacuum tube, or what is commonly called the Gassiot Star. The accompanying diagrams will assist our readers to understand the instrument: Fig. 1 gives a side view of Fig. 2. In the latter A represents the vacuum tube holder, B consists of a soft iron ring, within which is the rotating coil, C. A stationary coil is represented at D. Fig. 3 shows the speak-



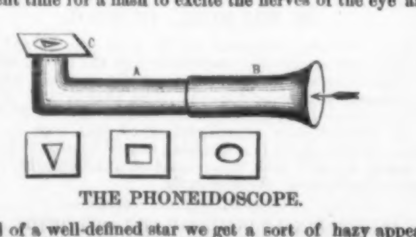
THE PHONOSCOPE No. 1.

ing tube, which consists of several parts, viz.: E, the mouth of the tube, F, a thin brass diaphragm, upon which, on the side opposite to E, is a thin strip of platinum. Contact is made and broken by means of a metal point on the brass



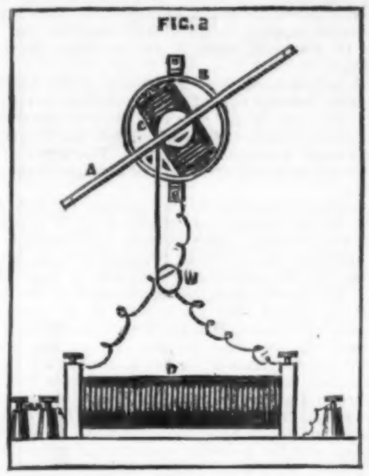
THE PHONOSCOPE No. 3.

strip, G. The last strip will be best seen in Fig. 4. One Grenet cell is connected up, so as to keep the vacuum tube rotating uniformly; a second cell is connected with D. If, while the tube is thus rotating, contact be made and broken once during the revolution, a single line of light will be observed, the position varying with the position of the tube during the revolution. The number of makes and breaks of contact during the revolution give the number of rays which the "star" will have. The number of flashes, however, to produce a star is limited, for if the tube revolves too fast and the contacts are made and broken too quickly, there is not sufficient time for a flash to excite the nerves of the eye and



THE PHONEIDOSCOPE.

instead of a well-defined star we get a sort of hazy appearance. Upon speaking into the transmitter the diaphragm vibrates, and contact is intermittently made and broken between F and G. This diaphragm in reality plays the part of a contact breaker in the Rhumkorff coil. The effect of speech upon the instrument is remarkable. The wave motion produced by sound is well known to be one of condensation and rarefaction. It would seem, therefore, that the alternate condensation and rarefaction of the sound wave acting on the diaphragm cause the make and break of contact, and hence the flash in the vacuum tube. Now the wave length—that is, the distance between two successive points of condensation or rarefaction—differs with each sound or note, and so each note produces its own particular star. Two notes in harmony produce two superimposed stars, the one bright and comparatively distinct, the other more nebulous and not so bright. Just as in acoustics we find two sounds may produce silence, and in the study of light that two lights may produce darkness, so we find interference



THE PHONOSCOPE No. 2.

admirably shown by this instrument, for two discordant notes break up all harmony of star rays, and we obtain nebulous haze with occasional flashes of light.

The second instrument is the phoneidoscope. The P's seem to be having it all their own way in scientific nomenclature, and future dictionary makers will have some difficulty in finding definitions for all these lengthy words. Mr. Sedley Taylor has added another to the list, but as it is the name of a very simple piece of apparatus, which shows some interesting and beautiful figures, we are bound to forgive him. Sonorous vibrations—thanks to Prof. D. E. Hughes—is a term almost as well understood as apple pie, and Mr. Taylor has been experimenting upon the action of sonorous vibrations on liquid films. The accompanying figure will explain the apparatus required for these investigations. A is a bent tube of about 1 inch diameter; an angle of gas tubing will do very well. B is an elastic tube with a mouth-piece. One limb of the tube A is horizontal, the other vertical. Upon the top of the vertical arm is placed a thin disk, out of which a piece has been cut. The opening thus made is filled with a film of soap solution. We have all blown soap bubbles in our boyish or girlish days, so it is not necessary to explain how this film is obtained, and we all know the beautiful color changes shown by the bubble as its thickness diminished in the sunshine. Having then obtained a film of soap solution it is watched till it becomes thin enough to exhibit these well-known color changes, and then the experiment may proceed. Laying the disk containing the film over the vertical opening, and speaking gently into the mouth-piece, the colors, instead of ever changing, immediately form well-defined patterns somewhat similar to the Chladni figures so admirably described and illustrated by Tyndall, in his work on "Sound," 2d edition, p. 143. Upon varying the note the figures rapidly change, each note having its own special pattern. For varying the pattern, differently shaped orifices for holding the films are used, some triangular, some circular, some elliptical, etc., it being found that the form of orifice—as in the case of Chladni's plates—influences the pattern when the vibrating surface is under the influence of the sonorous vibration. It must be remembered when speaking of all these discoveries that their tendency is to bring us nearer and nearer to that grand discovery which is sooner or later to be made, and which when made will show us the fundamental laws which regulate motion.

A NEW MERCURY TELEPHONE.

Telephonic experimentation appears at present to be interminable in Europe. A good portion of every issue of this journal might be made up of articles from our European exchanges on new forms and applications of this useful instrument and new theories concerning it. Among the new forms that are occasionally devised, we sometimes note one worthy of remark, as, for instance, the *Mercury Telephone* of M. Bréquet, of Paris. In this instrument the sending and receiving instruments are exactly alike, and the theory of its working is founded on electro-capillary phenomena—each instrument in fact being nothing more than a Lipmann's capillary electrometer. No battery is needed; the transmission of signals is practically independent of the resistance of the circuit.

The apparatus, which is extremely simple, consists of a glass tube open at one end and drawn out at the other to a capillary termination. The tube is supported in an upright position, its lower end dipping into a vessel of acidulated water, with a layer of mercury at the bottom. The tube is now filled three-fourths full of mercury and its upper end closed with the vibrating disk. Platinum wires fused into the glass connect the mercury in the tube and that in the vessel with the two wires of the telephonic circuit. The apparatus thus constituted serves indifferently as transmitter or receiver. The following appears to be the *modus operandi:* When the disk is set in vibration by the voice, it causes changes in the volume of the air inclosed in the space between it and the mercury in the tube. Consequently, the mercury in the tube advancing and receding, gives rise at every change in its position to a change in the electrical potential, which being transmitted through the wires of the circuit induces corresponding changes of position of the capillary column in the tube of the receiving instrument. As a matter of course, then, changes of volume follow in the air-space in this tube, which set the disk in vibrations that correspond with those in the disk of the sending instrument.

M. Bréquet's apparatus, although extremely simple, is in its present form quite unhandy, and the inventor is now engaged in experiments with M. Lipmann, with a view of

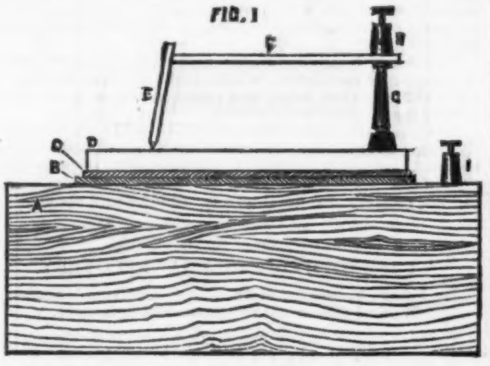
rendering it more portable. He is confident that his mercury telephone will, when perfected, become widely used, not only as a telephone, but for ordinary telegraphic purposes. It is proper to add that the successive phenomena observed here are precisely analogous to those that occur in Bell's telephone.

THE MICROPHONE.

By Mr. W. J. Lancaster, F.C.S., F.R.A.S.

During November and December of last year, I was making a series of experiments with the telephone, coupled to four Smee's cells, my aim being to work out, if possible, an instrument to act as receiver, and dependent upon the strength of current for the loudness of its tones. This I did not obtain—at any rate, not to my satisfaction, although I heard sounds upon either closing and opening circuit, and obtained these at will, by the use of a rotating commutator. Still, although I made exhaustive experiments, the only practical result I obtained was a receiver in the following form. This, I may add, is at present being adapted to the microphone, and produces very good effects. A number of thin pieces of soft iron wire, about ⅛ of an inch in diameter and 2 ins. long, were made into electro-magnets, and were first used as bar magnets, four of them being screwed together in the center, thus forming an eight-pointed cross. These I mounted in a flat box, 2 ins. deep and 2 ins. diameter, having eight surfaces, and opposite each surface a small piece of ferrotype plate, 1¾ in. long by ¾ in. wide, clamped

FIG. 1

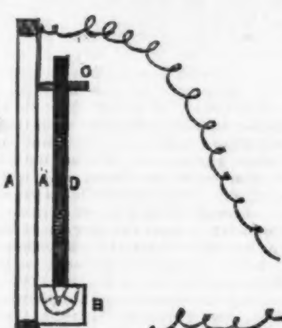


LANCASTER'S PILE MICROPHONE.

all round each plate for ⅛ in. The ends of the electro-magnets were as close up as possible, and with four cells in circuit they spoke fairly, although not so well as I had anticipated. Then I had four similar pieces bent into the horseshoe form, or more between the horseshoe and triangle form, having the poles as near together as the bobbins would allow. When the whole of the poles were collected into a space less than ¾ in. in diameter, under the same conditions as above, they spoke much better. These work very well indeed as a receiver with the microphone I am about to describe. Working mainly to obtain a receiver and not a transmitter caused me to overlook the sound produced by opening and closing the circuit, and in fact the whole thing was forgotten until the discovery of Professor Hughes was published. He followed up to a more successful issue his experiments, and I at once, on reading a note relative to his experiments, got out my cells that had been used only some three or four times since my last experiments, and repeated Hughes' experiments. I was not only pleased, but highly delighted with the results obtained by the intro-

FIG. 2

FIG. 3



LANCASTER MICROPHONES.

duction of a few grains of carbon into the circuit, and I soon found that the current required for the augmentation of the sounds produced near the carbons was of the weakest kind. One of my first microphones consisted of a halfpenny and a shilling with a layer of wet salt between them; by laying a thin plate of carbon on the top of the shilling, and connecting the telephone wires to the copper, and a second piece of loose carbon, I was able to hear very distinctly the sounds produced by a small camel hair brush, the ticking of a watch, etc., etc., through a hundred yards of thin copper wire. The same couple, with a pad of blotting paper soaked in dilute sulphuric acid, produced results much more appreciable. I then constructed a model which I have since called the Pile Microphone, and I intend describing this fully, so that any one may readily construct one. In the instrument I have combined the cell and microphone; in fact one of the elements forms at the same time a part of the microphone, which will be seen by referring to the following description:

A is a thin mahogany or pine box about 6 ins. by 4 ins. by 1 in.; the top should be as thin as it is possible to get mahogany; then upon the top of this screw a plate of zinc, B; this should be about 4 ins. by 2½ ins., and any thickness, the best thickness being about 1/16 in.; D is a gas carbon plate same size as B, but about ¼ in. thick; this is secured to the wooden upright, G, on the top of which another plate of carbon, much thinner than the bottom plate, is screwed. This plate is the most sensitive part of the microphone, and by a recent improvement I have succeeded in making it almost too sensitive. Against the plate F a thin upright carbon rod rests, touching a knife edge on the carbon plate; this is exceedingly delicate and never fails to work; the plate D has three or more small depressions in it, so made that the rod E may rest almost perpendicularly for very minute sounds, or at a low angle for loud sounds, or for transmitting speech. I have only a few days ago devised a simple addition in the form of a globule of mercury, which renders the instrument much more sensitive. It is this: Scoop out a space in carbon plate, D, immediately under the point the rod, E, touches when nearly perpendicular, sufficient to contain a large globule of mercury, then allow the rod to sink in the mercury; the rod does not go to the bottom, but remains in a condition of most delicate sensitiveness. To charge the instrument is a matter of a few seconds only; the pad of blotting paper, B, merely requires to be dipped in a weak solution of sulphuric acid, or salt and water, or vinegar. A simple form of microphone is shown by Fig. 2, where fixed on a thin box are two blocks, B and B, of carbon connected with the binding screws, D and D; and C, a thin piece of iron or steel wire pointed at both ends and fixed loosely in the carbon blocks, when connected to the pile or a cell; this form transmits sounds very easily and with a fair amount of intensity. Another simple form for auscultation is Fig. 3, where A A' are two very thin strips of wood glued to small pieces of wood top and bottom; between the two a strap passes and may be fastened round thorax or any part of body; B is the lower carbon, and is bored out in a manner represented by dotted lines, and contains a globule of mercury, also marked in dotted lines; into this dips the carbon rod, D, which passes through a hole in C, having a knife edge all round; the two wires go to the pile or a cell, and thence to the telephone. With this much good work may be done; but as an eminent physician said to me, "We shall have to unlearn all the sounds we know now, and learn others that are not yet tabulated." However, I hope the microphone may be of service in chest diseases. Some interesting experiments may be made with the microphone, among which the sound produced by a piece of iron when magnetized may be distinctly heard; another remarkable experiment is the heating of a knitting needle, placed on the upper plate of my pile microphone. By heating one end in a spirit flame a peculiar noise is emitted, evidently due to the molecular vibration passing through the wire. This will give an ample field to experimenters in determining the rapidity with which heat is conducted through given lengths of wire. The note produced by a tuning fork is heard at the telephone sufficiently loud to call the attention of every one in a large room. As entertaining experiments I may mention brushing either of the carbon plates with fine camel-hair pencil, a minute harp played on upper carbon with camel-hair pencil, a model of siren, also of Savart's toothed wheel, the latter giving either musical sounds or minute roarings resembling a huge cracker in the act of explosion, and, of course, the most amusing is the walking of a fly, which resembles, not the tramp of an elephant, to quote Sir Henry Thomson's words, but more like a horse's tread on a rough road.

With reference to the metallized carbon, I have had plates made with various percentages of iron, brass, copper, silver, zinc, and mercury, but have had no improved result by their use—in fact, I find nothing better than the arrangement I have mentioned above. I am making another model, which, I hope, will be more sensitive than any I have yet used. If successful, I will at once communicate the results. There is one point I may mention, and on which I am not willing to speak with any authority at present, but if I state the facts some one may be inclined to follow them up. It is that when using the microphone with a regular vibration of its parts I have noticed that the spark at points of contact is much intensified, and the greater the vibration so much more intense does the spark appear. My idea is that the vibration of the plate gives an impetus to the current, and thus causes it to jump over a longer distance, thus giving a more brilliant spark; and if this is so on a small plate, why not equally so in the production of a light produced by thirty or forty cells? Now that we have a cell—Dr. Byrne's—having an electro-motive force equal to ten Grove's, we ought to devise some method of using up such force for illuminating purposes.

Probably in the course of a few weeks we may hear of a successful application of the microphone to the determination of sounds in heart disease, etc. It will be of immense value to medical men if this instrument can be converted into a most delicate stethoscope, and I have hopes that it can be done.

I forgot to mention before that I used the pile microphone charged with ordinary tap water only, and that, when connected to a galvanometer, I could detect the most inaudible variation in the carbon plate by the declination of the needle. Speaking caused the needle to swing from 10 degrees to 30 degrees, and brushing the upper plate altogether reversed the current. This I was not prepared to find, as I had theorized that the sounds were augmented by the varying resistances in circuit, but on brushing to obtain it, a reversion of current was totally unlooked for.

REYNIER'S ELECTRIC LAMP.

In reference to this lamp, M. de Parville makes the following observations in the *Bulletin Français*: "With four Bunsen elements, we have just seen a very pretty electric light produced. The elements, which can be charged in five minutes, may be stowed away in a corner, in the cellar, etc., and one may be certain of having, during three or four hours, a splendid, vivid, and at the same time—if it be sifted through a suitable globe—a soft and rosy light. This is evidently an important step in the difficult problem of the electrical illumination of apartments and small workshops." Let us give a brief description of the new system: "When a platinum wire is interposed in the circuit of a battery, it may be sufficiently heated to emit a white light. If the wire be replaced by a thin rod of gas carbon, this also may be heated so as to produce a dazzling light. Such is the principle of the electric lamps acting by incandescence, of which various forms, more or less practical, were shown in Paris some years ago. A young electrical engineer, M. Reynier, has hit upon the idea of dispensing with all these complications, and of simply allowing the carbon to be consumed. The carbon, raised to a red-white heat by the electric current, is consumed by oxidation like the wick of a lamp; but its cost is not so great as to prevent its being replaced in the same manner. Thus is obtained an extremely simple electric lamp, which is managed with the same facility as an ordinary lamp. If much light is required the wick is turned up, *i.e.*, the heated portion of the carbon rod is augmented; if less light is needed, the wick is turned down. If the lamp is to be extinguished, the circuit is broken; if it is to be relit, a knob is turned, and the light flashes forth. Nothing can be simpler. The system is quite elementary. A rod, or rather a needle of carbon, from twenty to thirty centimeters long, and from one to two millimeters thick, is held at one end by a metal rod, which tends to descend by its own weight, and at the other end by a carbon wheel in a vertical position. The carbon rod is pressed strongly, whatever may be the consumption of the material, against this wheel, which is made to turn slowly. The current raises the carbon to a white heat at the point of contact of the extremity of the rod with the carbon wheel. The expenditure for charcoal is about 10 centimes per hour. Thus, a rod costing 30 centimes (3d.) will last for three hours, and without any magneto-machine or steam engine; but with a little battery of four to six elements, any one can have the electric light in his own home. The lamp which we saw in action is to be perfected with the least possible delay."

COMPOUND COLORS.—COLOR BLINDNESS.

Lord Rayleigh, in a recent Royal Institution lecture, showed that a combination of yellow and blue liquids produced green, and then explained that the result was due to the impurity of each color, and that if they had been absolutely pure the mixture would have been colorless. Various methods of combining colors were then exhibited. Thus, with polarized light, greenish-yellow and reddish-yellow gave white. With Professor Clerk Maxwell's apparatus two or three slits produce two or three spectra, and by their overlapping definite portions of the spectra may be mixed. The colors thus formed, or the white light thus produced, may be resolved by the prism into the component parts, and do not give a continuous spectrum. Lord Rayleigh said that red and yellow might be supposed to produce orange, the color of the spectrum between them, and Maxwell's experiments support this idea; but going upward from the red, the intermediate colors are not always produced by mixture. Thus, purple—a combination of red and blue—is not represented in the spectrum at all. The yellow of the spectrum can be exactly imitated by mixing red and green, and with due proportions of those colors all the shades of yellow and orange; hence it is concluded that green and not yellow is a primary color. By rotating disks with sectors of red and green a match was produced of yellow, white, and black; and his lordship obtained a yellow liquid by the mixture of chemical solutions, bichromate of potash (red) and litmus (blue). This color, when passed through a prism, gave red and green, without yellow, on the screen. To specify any color three elements are required—purity, depth (by black), and tint (by white). The three colors in the spectrum by which all others can be produced are red, green, and blue; but these colors, his lordship said, are not quite primary. In regard to the sensation of color, reference was made to Dr. Thomas Young's theory that we have three sets of nerves—for red, green, and blue respectively—the degree of color of the body looked at depending upon the amount of excitation of each of the sets of nerves. The threefold character of colors favors this view; but the explanation must be sought in the eye itself, as no one color can be pre-eminently termed primary, and Helmholtz has proved that the sensation of color partly depends on the state of the eye itself. Thus, after it has been fatigued by gazing on red and blue, the eye will be more excited by green. In the peculiarity termed "color blindness" blue and green are the only sensations produced in the eye, and to these all tints are referred. To persons who have this defect scarlet geraniums and their leaves are alike in color, and yellow is dark. Their eyes are not affected by any compound color into which red and blue enter. This was strikingly illustrated by the rotation of disks to produce matches of color, selected by a color-blind person. The colors which appeared green and blue to him were pink and pale blue to persons with normal sight.—*Illustrated London News.*

A POSSIBLE NEW FORCE IN THE SOLAR RAYS.

M. Forssman, who has been making investigations on the action of variously-colored lights on the galvanic conductivity of selenium, concludes that it is not the light vibrations, or certain kinds of them, that produce variations of conductive resistance, but vibrations of another order, which he thinks have neither lighting, heating, nor chemical action. This opens the road to further researches to discover whether this hypothesis be true, as, if so, its verification would be of the highest scientific importance, and amount practically to the revelation of a new mode of motion.

Procedures for the Restoration of Writing Effaced by Time.—By E. Von Bibra.—The author proposes to moisten the writing with a moderately concentrated solution of tannin, the excess of which is then removed by the application of the washing-bottle, and the paper dried at 65°.

Process for Seasoning New Casks.—By E. Von Bibra.—The author proposes to eliminate all soluble matter from the interior of the staves by the use of crystals of soda, of which 1 kilo. is used per hectoliter of the contents. The cask is first filled two-thirds full of clean water, the proper quantity of solution of soda is added, and after the liquid is mixed the cask is filled to the bung. After standing for ten or twelve days the alkaline liquid is run out, and the cask repeatedly rinsed with clean water.

New Discharge for Vat Blues.—By Oscar Scheurer.—The author prints on minium, and passes through weak hydrochloric acid, thus obtaining white designs very clear and well defined. Chrome-yellow, vermilion, Guignet's green, or other insoluble colors, thickened with albumen, may be associated with the minium.

Conversion of Magenta into Aniline-Violet.—By M. Vaucher.—The author observes that magenta dissolved in aldehyd takes on standing a violet shade, the change at common temperatures going on for two months.

Sugar is often mixed with ultramarine to hide or diminish its yellow color. If such is used for sweetening fruits, making jams, etc., the ultramarine is decomposed by the vegetable acids, with an offensive smell of sulphureted hydrogen.—*Deutsche Industrie Zeitung.*

HISTOLOGY AND THE CELLULAR THEORY.

By Dr. Edward Fournié.

Translated for the Scientific American Supplement *from the Gazette des Hopitaux.*

[Dr. E. Fournié is on the point of publishing a very remarkable work entitled "*The Application of the Sciences to Medicine.*" It is so excellent that our readers will no doubt be pleased to have a few pages from a special chapter in which the author exposes the present state of anatomy and physiology.]

I.

It is a deplorable disease, and at least a singular one, which, since the commencement of the present century, has impelled a certain number of our national *savants* to consider Germany as the source of all light and of all progress. The first symptoms of this mental aberration may be traced to the period of the first publication of Mme. de Staël on Germany. *Littérateurs* and philosophers were at first the propagators of the contagion, and they acquitted themselves of this task with an enthusiasm worthy of a better cause. Then followed certain *savants*, who, finding the public attention occupied by the exalted personages who had made France illustrious from 1830 until our own day, shrank from the task, assuredly difficult, of connecting the later years with the former by a continuous chain of scientific discoveries, and who preferred to study with our neighbors the science which they did not know how to do among ourselves. This incursion into Germany has served the interests of some, but French science has drawn but little from it, and the most evident of its acquisitions consists in the introduction of some new theories of a very doubtful utility, which too often serve as a ready passport to illegitimate aims. Let us hear what M. Robin, who is beyond contradiction the man in France who is most competent in these matters, has to say.

"To *explain* everything," says he, "there is nothing easier for one who knows how to write fluently of an injured tissue, that, becoming the seat of an *active process*, irritation *invades its cellules*, which *undergo* a *commotion of an irritative nature;* that the *irritative process*, there producing itself, occasions transformation or fatty degeneration of their *protoplasm*, that is to say, chemical phenomena, and elsewhere it causes *formative superactivity* with *proliferation of nuclei*, metamorphosing themselves or not; but it must be said that all this occurs under the pen of the writer only, for as soon as we attempt to prove this transmutation, agreement ceases, and observation shows that those who deny it are in the right."[1]

We would not criticise more minutely the abuse of Germanic importations. But this criticism assists us to comprehend why Virchow, in a moment of *humor*, designates certain of our *savants* under the name of *microscopists of the West.*[2] Naturally! Is it not from the East that we receive our light?

The infatuation for Germanic science has been pushed so far in these last few years that very many people imagine that histology and everything that pertains to the microscope is of Germanic production. What follows will set right this error.

Let us first take up the subject of the instrument itself. It is true that the invention of the microscope is due to a Hollander by the name of Janssen (1590); it is no less certain that this instrument has rendered its greatest services since the time that Selligues had the idea of perfecting it by the application of the laws of achromatism. The first achromatic microscope was constructed by Chevallier and presented to the Academy of Sciences in the month of August, 1824.[3]

As regards microscopic labors, it is undeniable that they have not been pursued in France with the same enthusiastic ardor as by foreigners; but those individuals who, among us, have devoted themselves exclusively to these labors have been able to maintain microscopic anatomy in a progressive track, both in establishing their systems and in rejecting what was useless that came to us in great pomp from the East.

In the appreciation of this question, we must take into consideration and separate the methods, the theories and the hypotheses from those definite ideas acquired through the instrumentality of the microscope. The former have often been wrong and have detracted from the number and importance of the latter.

Let us first examine, then, the theories that have been set on foot by microscopic labors.

The most of these theories are to-day confounded under the name of the *cellular theory*, because the mode of formation and development of the cellules is the common basis of it.

De Mirbel, a French botanist, was the first to admit the cell as an organic unit, and the point of departure of the other tissues. "The vegetable," says he, "is originally formed essentially of a simple cellular tissue which undergoes diverse modifications as the effect of development."[4] "The tubes and the vessels of plants," says he again, "are only very elongated cells."[5]

These affirmations are not simply imaginary views; De Mirbel established the enlargement of the cellule into the ampulla, and its development into a duct. He admitted three modes of cellular generation: intra-utricular generation (endogenesis), super-utricular (exogenesis or gemmation), and inter-utricular (free formation); but he insisted on this fact, that "it is not by the aggregation of utricles, at first free, that the cellular tissue of plants is produced, but by the *generative force* of a first utricle, which *begets* others endowed with the same property" (cellular proliferation of Virchow).

"These cellules," adds he finally, "are like living individuals, each enjoying the properties of growing, of multiplying and of modifying themselves within certain limits, and which are the constituent materials of plants. The plant is then a collective being" (adopted also by Virchow).[6]

We see by these quotations that the principal dogmas of the *cellular theory* had been formulated long before the Germans had invented the name of *cellular theory.*

Very nearly at the same period, another botanist, Turpin, published a work entitled: *Microscopic organization, elementary and comparative, of vegetables; observations on the origin and primitive formation of cellular tissue, on each of the component vesicles of that tissue considered as being distinct individualities, having their particular vital center of vegetation and of propagation, and destined to form by agglomeration the compound individuality of every vegetable the organization of the mass of which comprises more than one vesicle.*[7]

This title needs no commentaries; it proves clearly that all the fundamental ideas that we have since united together under the name of the *cellular theory* had been expressed and in great part demonstrated by Turpin. As regards particular ideas we shall confine ourselves to saying that Turpin was the partisan of endogenous development, and of the cell type.

"A tree," says he, "*like every other organized being*, commences from a single globule; this globule, a propagator of its characteristics, grows, and becomes vesicular; from the interior walls of this vesicle arise, by extension, a new generation of globules likewise having the properties of propagation; these last, in growing larger and in filling to its utmost capacity the *mother-vesicle* which can no longer contain them, cause the latter to rupture and turn out a numerous generation of individuals which form a mass, which coalesce more or less among themselves, and continue in their turn to generate new individuals, to multiply their number, and to augment the extent of the mass."[8]

De Mirbel did not venture to apply his method of examination to animal tissues; Turpin did venture to make this application, but without demonstrating the conditions; Dutrochet, in 1824, was altogether affirmative on this point.

"Everything arises," says he, "from the cell in the organic tissue of vegetables, and observation leads us to assert positively that it is the same in animals."[9]

In 1825 Raspail maintained the same positions in some remarkable works. "Every tissue, animal or vegetable," says he, "is only a modification of this structure (cellular); the vessels are formed in the same manner in the one as in the other kingdom, so that it appears to me that the time is not far distant when, without being taxed with boastfulness or temerity, we may put forth this purely scientific challenge: Give me a vesicle in the midst of which other vesicles may be elaborated according to my will, and I will give back to you the organized world."[10]

The prophecy has never been realized, evidently, notwithstanding that the Germans were of that opinion, and particularly Schleiden, who appropriated the formula and gave to it a semblance of consecration.

At the same epoch, 1826, Royer-Collard put forth the same ideas, though in a more complete manner, before the Anatomical Society.

The *Compte Rendu* of Lenoir for the year 1826 shows us, indeed, that Royer-Collard recognized three successive degrees of organization:

"1st. *The amorphous organic state*, which, in its normal productions, bears the name of *succus formativus*, and its morbid productions the name of *plastic lymph;* this is what the Germans call *blastema.* 2d. *The globulous state* succeeds the preceding; it is permanent among the inferior animals; it is only transitory in the embryo of beings whose organization is higher in the scale; but it is still found in some adult tissues and in certain pathological productions. 3d. *The fibrous and laminary state*, finally, is the definite state of complicated tissues."[11]

In 1829 G. L. Duvernois expressed himself in these terms:

"Round vesicles, globular in form, or more or less elongated, compose the living tissues of all organized bodies; but the elementary molecule of their inactive tissues perhaps has facets, such as we see in the earthy parts of animals. These vesicles form others which, by their apposition, by the varied compression that they exercise one on another, take different figures. Such is the first degree of organization of these tissues.

"When the cells form membranes rolled upon themselves to act as tubes or vessels a complication results, a perfection of organization which distinguishes in the two kingdoms the more simple animals and vegetables from those whose organization, more complicated, seems to us to be more perfect."[12]

For the word *vesicle* we have only to substitute the word *cell* to have proof that at that epoch the doctrine of the formation of complex organisms by an infinity of elements was already classic, thanks to the work of French scientists.

While De Mirbel, Turpin, Dutrochet, Raspail and Royer-Collard explained the fundamental dogmas of the *cellular theory* and left nothing more to be done on this point, other observers, especially occupied in the study of the birth and development of the animal embryo, collected new facts which have furnished to histogenesis its chief principles. Thus Dumas and Prévost, in 1825, saw twice on the ovary of the bitch, the egg inclosed in the Graafian vesicle, before Ernest de Baer formally discovered that organ.[13] The same authors had already proven that the spermatozoids penetrate through the albuminous envelope of the egg to the surface of the vitellus, by bathing the eggs of a frog with semen which they had colored.[14] Finally, Dumas and Prévost were the first to point out such an important phenomenon as the segmentation of the yolk.[15]

At the same epoch Coste commenced his splendid career, in which he made himself illustrious by the discovery of the *germinative vesicle* in the egg of mammals. This discovery permitted him to complete that of De Baer, and to give to it its true physiological signification. We know, indeed, that De Baer compared the egg of mammals to the vesicle that Purkinge had already discovered in the egg of birds. It was to compare and identify a complete whole with one of the parts of that whole. Such a comparison would have reduced to nothing the results of the discovery if Coste had not demonstrated that in the eggs of mammals there exists a germinative vesicle analogous to that of Purkinge.[16] In 1837 Coste further demonstrated that at the period of rut the eggs, in mammals, fell *spontaneously* from the ovary. Finally, a little later, he established, with other embryologists, the existence of two layers of blastoderm which would, with the middle layer, give rise to the organs of the embryo.

The quotations that precede should suffice to prove to us that the theories that have been inspired by microscopic studies have not come in all cases from our neighbors across the Rhine. This truth will appear even more plainly from what follows.

A few years after these ideas were expressed and the facts demonstrated were brought to the knowledge of all, the first German work on the subject appeared. Schleiden, the author of that work, entitled *Beitrage über Phytogenesis*, and which appeared in *Archiv für Anat. und Physiol.* (Berlin, 1838), was familiar with these facts, and what proves it, is that in his preamble he expresses himself in these terms:

"I may allow myself to pass over," says he, "a historical introduction, for, to my knowledge, no one has as yet made any direct observation on the development of the cells of plants. We have known for a long time that the pretended primitive cells of Sprengel are grains of solid starch, *and to occupy my attention with the work of Raspail does not seem to me* compatible with the dignity of science."

It is thus that Schleiden disembarrasses himself of the already acquired rights to priority.

"Behold here dignity very usefully outraged," justly cries M. Broca about this, "but the jackdaw of the fable nevertheless did not insult the peacock."[17]

The constitution of the cell had already been known for a long time. R. Brown, in 1831, had discovered the nucleus in the cells of asclepiades and orchids.[18] Schleiden designates the nucleus under the name of cytoblast, the nucleolus under that of little nucleus, and, to appear altogether original, he admits that all around the nucleus is developed a transparent vesicle, representing a small segment of a flattened sphere, analogous to a watch glass laid on its rim. According to Virchow this spherical membrane "is known under the name of the watch glass form."[19] We should never have doubted it.

This vesicle is only the commencement of the development of the cellular membrane, which, little by little, absorbs it, takes the spherical form, and preserves on a point of its surface the unfortunate cytoblast.

As regards the birth of the cells, this would be more simple according to Schleiden; the nucleolus appears first, formed by small granulations; then a granular mass disposes itself around the nucleolus to form the nucleus, and finally the cellular membrane is developed as we have said above.

(*To be continued.*)

[1] Ch. Robin, *Anatomie et physiologie cellulaire*, p. 667.

[2] Virchow, *Pathologie cellulaire*, p. 51.

[3] P. Broca, *Traité des tumeurs*, vol. i, p. 20.

[4] Mirbel, *Memoir sur l'origine, le developpement, et l'organisation, au liber et du bois*, read at the Academy of Sciences in 1827.

[5] Mirbel, *Exposition de la theorie de l'organisation vegetale.* Paris, 1809. These quotations are incorporated by M. Robin, *Anat. et phys. cellulaire*, p. 561.

[6] Mirbel, *Cours complet d'agriculture;* in Robin, p. 563.

[7] Turpin, *Memoires du museum d'histoire naturelle*, 1826, vol. xviii., p. 161; in Robin, p. 559.

[8] Quotation printed by M. Robin, p. 560.

[9] Dutrochet, *Recherches sur la structure intime des animaux et des vegetaux.* Paris, 1824.

[10] Raspail, *Recherches physiologiques sur les graines et le tissu adipeux* dans le *Repertoire d'anat. et de phys.* de Breschet, vol. iii., p. 174. Paris, 1827. Citations printed by Broca, *Traite des tumeurs*, vol. i., p. 30.

[11] Quotation printed in the text of M. Broca, *Traite des tumeurs*, vol. i, p. 31.

[12] *Dictionnaire des sciences naturelles*, vol. lviii., p. 82, article *Vie*, 1829.

[13] Annales des Sciences Naturelles, 1st series, vol. iii., p. 135.

[14] Annales des Sciences Naturelles, 1st series, vol. ii., p. 129.

[15] Annales des Sciences Naturelles, 1st series, vol. ii., p. 129.

[16] Coste, *Recherches sur la generation des mammiferes.* Paris, 1834.

[17] Broca, *Traite des tumeurs*, vol. i., p. 33.

[18] R. Brown, *Observations on the organs and mode of fecundation in orchidæ and asclepiadeæ.* London, 1831.

[19] Virchow, *Pathologie cellulaire*, p. 9. And it is thus that history is written.

A CASE OF HYDROPHOBIA—RECOVERY.

By James Nicholls, M.D., F.R.C.S. (Exam.), Senior Medical Officer to the Chelmsford Infirmary.

T. H——, aged twenty-five years, a very muscular, active little man, a merchant's carter, who, to use his own words, had never had a day's illness, about the first week in January of this year, and just seven weeks before the first hereafter-mentioned date, was bitten by a small white stray dog on the leg, whose history and end cannot now be traced. This happened on the public road ten miles from Chelmsford, and near no houses. A fatal case of hydrophobia had occurred in the town near which this took place, and several dogs known to have been bitten were still at large in the neighborhood. The bite was through a thin white stocking, above the boot, his trowsers at the time being turned up. Blood flowed, and he states that the wound smarted. Before reaching his home he mentioned the circumstance to two persons, and showed the blood-mark. At home he said not a word about it, and gives as his reason that his wife was ill at the time, and he did not wish to alarm her; but he subsequently mentioned it to two of his fellow-workmen, to whom, when asked if he had had anything done, he replied, "No; I have been bitten before and no harm came of it." The wound healed, and from this time up to Thursday, the 7th of March, he says he thought little or nothing about it, slept well, and kept in good health.

I may here remark that, although able to read and write, H—— had never seen or heard anything of or about the signs or symptoms of hydrophobia, nor had he held any conversation with any one on the subject.

Now comes his account of himself as long as he can remember. On the Thursday, which was the 7th of March, he did not feel well—weary, tired, and aching in both legs. On returning home early from work he took off his boots, bathed his feet and legs, and rested them. On the following day he felt much the same, but added that "all his body ached," and his appetite failed. On Saturday, the 9th, he delivered a load of coal at my own house, and refused his customary glass of ale, saying he could not drink it—a fact remembered by my cook as well as by myself. On Sunday, the 10th, his wife says he was irritable, restless, drowsy, and extremely thirsty, drinking through the day some six or seven pints of coffee, taking no solid food, and complaining of the slightest noise—a toy windmill outside his house proving a great annoyance. During the whole day at intervals he complained of his throat, and, as he said, "gulped down his coffee." Through the night he slept well.

Now commenced symptoms of a graver and more distinctive character. After dressing, he called to his wife and said he was unable to drink the porter left for his use from the night before, going to his work without taking anything. Having delivered a load of coals in the country, he called at a public-house, and after three efforts got down a pint of ale, remarking at the time, "I am as thirsty as ever," when another man passed his cup to him. He attempted to sip, but failed. Leaving the house he went to the wharf, took a load of coal, drove into the town, and dashed through one of the streets at full gallop, from which time he says he remembers nothing until the Friday following.

On Monday, March 11th, at half-past one in the afternoon, I was sent for to see a case of "a man in a fit." Arriving in a few minutes, I found the patient on the brick floor of a room, the furniture broken, the fire torn out and scattered about, and the whole place in the utmost confusion. His legs were tied with a stout rope, and he was beating his arms and head and struggling furiously. Countenance livid; frothing at mouth, and jaws clinched; cold perspiration standing on face and forehead; pulse low—indeed it could scarcely be felt in consequence of his convulsions; respiration was slow, deep, and labored. He was uttering a most peculiar noise, between a howl and a scream. After a few minutes passed in this way he suddenly turned on his side and was very sick, bringing up some bilious, frothy mucus, kept for examination. Opening his eyes, he became

for about a minute partially conscious, and in answer to every question replied, "Oh, my chest! oh, my chest! they have hurt my chest!" He then relapsed into unconsciousness, and renewed and more severe tetanic convulsions came on. My first question to those around was, "Has this man been bitten by a dog?" to which a reply *in the negative* was given by all, their only knowledge of the facts being that on eating or attempting to eat the first mouthful of his dinner he rushed from the room and fell into the state in which I found him on my arrival. Seeing that it was neither a case of drunkenness, epilepsy, nor ordinary tetanus, I ordered his removal to his own home. It required the efforts of four strong men to get him into and restrain him in a cart. On arriving at his house, his wife not being able to accommodate him, he was at once taken to the infirmary, where I was ready to receive him. All the symptoms continued. I had him placed as he was in his clothes on a mattress on the floor of an empty room. He again vomited, but this time did not become conscious. His struggles were most violent, so I at once gave him some chloroform on a sponge, an inhaler being out of the question. This quieted him, and we took the opportunity of putting him into a strait waistcoat and further securing his legs. Before the administration of the chloroform there was the most complete opisthotonos; the diaphragm was deeply arched; the abdomen presented a most peculiar hollow appearance; the pectoral, intercostal, and other muscles of respiration stood out in bold relief; the muscles of the extremities, when touched, contracting like cords. Soon after this my colleague, Mr. Carter, arrived (to whom I am indebted for the most valuable part of these notes), and from this time the patient was under our joint care. During the afternoon and up to 10 o'clock at night he was kept by two strong men almost continuously under the influence of chloroform; tetanic spasms existing, but much reduced in force, and only completely absent when the patient was thoroughly under the influence of the anæsthetic. I had never seen opisthotonos so strongly marked, he resting on his head and heels for quite a minute at a time. Between 9 and 10 o'clock at night, several medical men having seen him, it was agreed to try, besides the chloroform, a hypodermic injection of the Calabar bean and morphia. I injected twenty minims of Corbyn's solution of the latter (six minims to the grain) and one-third of a grain of the extract of Calabar bean in solution. His pulse at this time was firmer, about 76; trismus less severe, and he seemed to hear loud noises; respiration was deep and irregular. During the night he slept several times, but on his awaking the convulsions invariably recommenced, and his attendants at once administered chloroform until again quieted.

March 12th.—After four o'clock on this morning the patient had snatches of sleep without chloroform, but still there was subdued tetanic convulsions of all the muscles. The same injections were repeated three times during this day. In the evening he became more conscious, asked for drink, which he swallowed in small quantities in gulps, the greater portion being spasmodically expelled from his mouth.

13th.—The patient had a better night, and required no chloroform. He had passed no urine from the moment of his attack; I therefore introduced, with the greatest difficulty, a catheter, the spasms of the muscles of the urethra being very strong. The urine drawn off was moderate in quantity, and quite healthy. On being asked in a loud voice, he would put out his tongue. The temperature and pulse were nearly normal, the pupils were contracted, and the skin very dry. On his seeming uneasy, the catheter was passed three times on this day. He called for drink, and at times attempted to swallow with avidity, but this always produced spasm, and he would bite the cup. Now and then he would reply in monosyllables to a question.

14th.—Had a quieter night, and at times slept a quarter of an hour without spasms. Drank beef-tea, and that with less effort. Passed catheter without much difficulty three times during the day. No action of bowels. Placed ten grains of calomel on tongue, and gave an injection per rectum of castor-oil, gruel, and turpentine. No result. Displayed the greatest horror of anything white—for example, the white bandage on the matron's broken arm, a white basin, gloves, etc., at sight of any of which he would turn aside and become convulsed. This peculiar symptom continued for two or three days after this date, and even after he was perfectly conscious.

15th.—Passed catheter twice; spasms less; drank rather better. For the first time became conscious of where he was from seeing the words "Chelmsford Infirmary" on the outside of a book. Repeated the injection per rectum again, with no effect; two subcutaneous injections of morphia as before.

16th.—Slightly improved, but had during the night the most violent spasms for an hour or two, so much so that I was sent for. Visited him three times during the day. He required the catheter twice, and he had two subcutaneous injections of morphia. In the evening he was seen by Dr. Burdon-Sanderson and Mr. Callender.

17th.—More conscious. Two injections of morphia; drinks better. Catheter once; was sick once. An injection of turpentine and oil per rectum. Pulse and temperature normal.

18th.—Had a good night, and passed urine without catheter. Bowels were relieved for the first time, and he was conscious of it. Sick once.

19th.—Had very strong tetanic convulsions during the night, and was most restless, but improved again during the day. Anything white still irritated him and caused spasm. When inclined he now drinks freely, but does not like to be asked to do so.

20th, 21st, and 22d.—An injection once a day of the morphia kept him tolerably free from spasm; his bowels moved naturally, and he passed his urine without assistance. He dislikes being talked to, and objects to persons walking across the room or any noise. Drinks freely when so inclined. His voice and manner are most peculiar.

23d.—No injection of morphia required; the spasms almost gone. Washed and dressed him and removed him to another room.

From this time he improved without further treatment, and on the 26th walked into the garden, and a few days later returned to his home, and thence went into Cambridgeshire for quiet and change. He returned on May 14th quite recovered, and is now at work, feeling, as he says, "quite well, but rather weak."

THE CHELMSFORD CASE OF HYDROPHOBIA.

OUR readers will find on the previous page an account by Dr. Nicholls of the recovery from hydrophobia which lately occurred under his care at Chelmsford. The details which he supplies are of the greatest interest and importance. The bite was received seven weeks before the earliest symptom. A period of three days' restlessness and occasional difficulty in swallowing ended in the sudden onset of a condition of maniacal convulsion, the spasm being most severe and tetaniform in character, and recurring at first almost constantly, except when the patient was under the influence of chloroform, and afterward in paroxysms for a week or ten days, when they ceased, although slight psychical disturbance continued for a longer time. During the most intense stage of the disease an attempt to drink always produced spasm, and it was excited also by the sight of any white object. The man had no fever, but retention of urine and most obstinate constipation. The tetanic character of the spasms was remarkable; it was marked in the earliest as well as in the later convulsions, and the opisthotonos was extreme, so that during the paroxysms the man rested on his head and his heels. Trismus was also present, and increased the resemblance to tetanus, and the case was at first regarded as of that nature. The treatment adopted was the inhalation of chloroform and the hypodermic injection of Calabar bean and morphia at first, and afterward of morphia only, three grains of Calabar bean and forty grains of morphia being injected, Dr. Nicholls informs us, in twenty-one or twenty-two injections.

Dr. Nicholls tells the history of the case without note or comment, and in this he is wise, for the simple facts constitute one of the most valuable contributions which the literature of hydrophobia has received. Doubtless the case will be received with hesitation by some because the patient recovered, by others because the symptoms were not absolutely typical. But as an instance of recovery it does not stand alone, even among well-authenticated cases, and the deviation of its symptoms from the most common type is by no means an unusual character in cases of hydrophobia. We pointed out a few weeks ago how frequently mistakes in diagnosis are made, on account of the extreme preponderance of some one of the symptoms or groups of symptoms which characterize the disease. In one the symptoms are mainly psychical, and the case is recorded as one of mania, symptoms of respiratory spasm and of convulsion being subordinate; in another the latter are chiefly marked, and the case is tetanoid in its aspect, as in that on which we then commented, and as in the case which Dr. Nicholls records to-day. The preceding bite from a dog probably rabid, the incubation period, the absence of any mental anxiety, the early pharyngeal symptoms, all point to the case being one of true hydrophobia so strongly, that the intensely tetanoid character of the spasm cannot be held as militating against the conclusion. Regarding the remedies employed there is little to be said; they were not new, and had been used before in many cases without success, but the recovery of the patient is no doubt to be ascribed largely to the perseverance and energy with which they were employed.—*Lancet.*

CHEMICAL SOCIETY, LONDON.

"*Action of the Copper-Zinc Couple.*"—By J. H. GLADSTONE, F. R. S., and ALFRED TRIBE.—The authors have recently shown that finely-divided copper, charged with hydrogen, converts niter into potassium nitrite and ammonia; they have since found that hydrogen, in association with the same metal, reduces potassium chlorate to the chloride. They have observed that the copper-zinc couple, in the presence of water, converts nitrobenzol into aniline, a reaction which the authors have utilized for the detection of small quantities of nitrobenzol, as follows: "Add some twelve drops of strong copper sulphate solution to three or four pieces of zinc foil (1 inch by ½ inch) in about 5 c.c. of water, wait till the liquid is completely decolorized, pour off the zinc sulphate solution, and wash the conjoined metals three or four times with water. Now add to this couple the nitrobenzol in solution, or in suspension in water, heat nearly to boiling point for about two minutes, filter, cool, and add, drop by drop, a solution of bleaching powder. The nitrobenzol in 5 c.c. of an 0·05 per cent. solution in water can thus be detected." The paper contains chiefly the results of the authors as to the actions of palladium-hydrogen, platinum-hydrogen and carbon (cocoa-nut charcoal) hydrogen on various substances.

In conclusion the authors draw attention to the close analogy between the action of the copper-zinc couple, of occluded and of nascent hydrogen in some cases, and point out that the results corroborate their previous view that the power of the copper-zinc couple depends to a great extent on the hydrogen absorbed by the finely-divided metal. They also discuss various explanations of the above reactions. The paper was illustrated by some experiments which were performed by Mr. Tribe.

"*Alkaloids of the Aconites.*" Part III.—By C. R. A. WRIGHT and A. P. LUFF.—The authors find that aconitin is readily dehydrated by heating in contact with acids (preferably tartaric) forming apoaconitine $C_{33}H_{43}NO_{12} = H_2O + C_{33}H_{41}NO_{11}$. The new base closely resembles the parent alkaloid, and is formed from it during extraction to some extent; its hydrobromide appears to be more soluble than aconitin hydrobromide, as the mixture of bases yields pure aconitin on conversion into hydrobromide, recrystallization and regeneration of the alkaloid. By saponification aconitin splits up $C_{33}H_{43}NO_{12} + H_2O = C_7H_6O_2 + C_{26}H_{39}NO_{11}$, forming benzoic acid and a new alkaloid aconine readily soluble in water and chloroform, insoluble in ether. Probably the substances described as napelline and acolyetine by Hübschmann are aconine, more or less pure. On treating aconitin with acetic or benzoic anhydrides it loses water, and forms a derivative in which H is replaced by an acid radical. Besides crystallizable aconitin, *A. napellus* yields a considerable quantity of non-crystalline alkaloids, which contain more carbon and are of lower molecular weight than aconitin; these are probably formed from aconitin by alteration during extraction. One conclusion to which the authors call special attention, drawn from the above research, is that no practical difficulty exists in preparing from *A. ferox* and *A. napellus* well crystallized salts or alkaloids of constant composition and high physiological activity, whence it is evident that the amorphous preparations now sold as aconitin, which vary immensely, should be replaced by pure crystallized alkaloids. The commercial product often contains 40 and even 80 to 90 per cent. of uncrystallizable bases more or less inert.

"*Alkaloids of the Veratrums.*" Part I. Alkaloids of *Veratrum sabadilla* (*Assagrœa officinalis*). By C. R. A. WRIGHT and A. P. LUFF.—The authors discuss the results obtained by previous observers, Couerbe, Merck, Weigelin, Schmidt and Röppen. The discrepancies observed between the results of these chemists are due to the alteration and decomposition of the original bases during the process of extraction and purification. The authors have examined the alkaloids obtained from *V. sabadilla* seeds by percolating the crushed seeds with alcoholic tartaric acid, evaporation, separation from resin and extraction by numerous and prolonged shakings with ether. The alkaloids obtained were three:—(1) Veratrine (Couerbe) $C_{37}H_{53}NO_{11}$, on saponification it splits up $C_{37}H_{53}NO_{11} + H_2O = C_9H_{10}O_4 + C_{28}H_{45}NO_8$ (dimethylprotocatechnic acid being formed; this acid is identical with Merck's veratric acid, and the acid obtained by similar treatment from pseudaconitin) and a new base, verin. The authors propose to restrict the name "veratrin" to the above alkaloid; it does not crystallize, but its sulphate and hydrochloride can be obtained in the crystalline state. (2) Cevadin (veratrin of Merck) $C_{32}H_{49}NO_9$; this alkaloid was obtained by Merck, and Schmidt and Röpper, who assigned to it a slightly different formula. Weigelin also obtained this substance in a very impure condition. On saponification it splits up, $C_{32}H_{49}NO_9 + H_2O = C_5H_8O_2 + C_{27}H_{43}NO_8$, forming a new base, cevine, and an acid identified as methylcrotonic acid, and with the cevadic acid of Pelletier and Caventon; the benzoyl compound is beautifully crystalline. The formula of cevadin is probably

$$C_{27}H_{41}NO_6 \begin{cases} -OH \\ -O.COC(CH_3)=C_2H_4, \end{cases}$$

and is probably closely connected with the aconite alkaloids. (3) A new base, amorphous, yielding no crystallizable salts, and forming cevadic acid on saponification having a formula $C_{34}H_{53}NO_8$. This body resembles, to a certain extent, Weigelin's sabadillin, but in other respects is quite dissimilar. The authors propose to call it *cevadilline.* No trace of anything like Weigelin's sabadillin could be detected; a commercial product sold as "sabadillin" consisted chiefly of cevadillin. The above papers contain the details of 40 to 50 analyses and quantitative determinations.

Dr. Gladstone said the society had to thank the authors for the large amount of labor which they had bestowed on a subject of much difficulty, and for the positive knowledge which was now gained of substances most undesirable to work with, in place of the varying statements hitherto published.

In answer to Mr. Maxwell Syte, Dr. Wright said that the above alkaloids gave for the most part color-reactions with sulphuric acid, but it was difficult to distinguish the colors when a small quantity of the alkaloid was present with much organic matter.

"*Action of Hydrochloric Acid upon Chemical Compounds.*"—By J. W. THOMAS.—The author has studied the action of hydrochloric acid on various substances in three ways: (1) Chemical compounds were introduced into tubes containing hydrochloric acid gas standing over mercury. (2) A current of dry hydrochloric acid was passed over chemical compounds placed in a glass tube. (3) Chemical compounds were dissolved in water and different proportions of hydrochloric acid added, and then distilled over a water bath at 100°, or in a vacuum at 15° or 30°. By these methods the action of hydrochloric acid on many salts has been examined. The list includes various nitrates, tartrates, citrates, chromates, antimoniates, hypochlorites, sulphates, permanganates, ferro-cyanides, oxalates, etc., in all about thirty salts.

"*Action of Oxides on Salts.*" Part I.—By E. J. MILLS, D.Sc., and D. WILSON.—The object of the present research is to determine the law in consequence of which the action of oxides on salts leads in general to the formation of other oxides derived from the salts in question. The authors have investigated at present the action of tungstic, silicic and titanic oxides on potassic carbonate at a high temperature by determining the loss of weight (from the escape of CO_2) during ignition. The reactions have been studied with great care, and corrections from various errors carefully made. The authors give several formulæ deduced from their experimental results. One of the results arrived at is that the chemical effect of an oxide and a carbonate acting on one another under the conditions specified is directly proportional to the product of their active masses, and inversely proportional to the sum of their residues. The authors conclude their paper with the following inference: that Brodie's fundamental equation represents the mutual action of two bodies under unit conditions, apart from change of weight, and with the unit of chemical effect.

"*A New Test for Glycerine.*"—By A. SENIER, M. D., and A. J. G. LOWE.—This test is founded on the fact observed by Iles, that borax, when treated with glycerine, gives to a Bunsen flame the green color characteristic of boracic acid. The test is applied by the authors thus: The solution is rendered slightly alkaline by dilute soda and a borax bead placed in it for a short time. The bead is then held in a Bunsen flame; if the solution contains one per cent. of glycerine a distinct reaction is observed; erythrite and glycol give the same color, or a little of the solution is mixed with some powdered borax, and some of the mixture placed on a platinum loop and treated as before. By means of this test, after concentration, etc., $\frac{1}{10}$th of a per cent. of glycerine was detected in beer, one per cent. in sherry, one per cent. in milk, five per cent. in treacle. During the reading of the last papers, Mr. Warington occupied the chair.

"*Ammonium Tri-iodide.*"—By G. S. JOHNSON.—The author has prepared this substance by dissolving iodine to saturation in a strong aqueous solution of ammonium iodide, and (2) by stirring crystals of ammonium iodide and iodine with a small quantity of water till the resulting black liquid refused to dissolve more of either ingredient. The liquid was evaporated over sulphuric acid, and in a few days crystallized. No iodide of nitrogen was formed. This substance is more stable than the corresponding potassium salt. NH_4I_3 crystallizes in dark blue prisms, usually tabular and isolated; it is soluble in a small, but decomposed (with deposition of iodine) by a large quantity of water, slightly deliquescent; but when heated loses iodine, and becomes coated with NH_4I, without fusing: sp. gr. of crystals, 3·749: at. vol., 103·07.

Specimens of the alkaloids obtained by Wright and Luff and of ammonium tri-iodide were exhibited; also some combustion furnaces from Messrs. Bel.

THE APPLICATION OF ORGANIC ACIDS TO THE DETERMINATION OF MINERALS.

A MINERALOGICAL excursion undertaken in 1876 among the rugged mountain regions of North Carolina having demonstrated the impracticability of transporting liquid mineral acids in such localities, Dr. H. C. Bolton was led to make some experiments in regard to the behavior of minerals with solutions of citric and tartaric acids, which may be readily carried in a solid state. The organic acids have long been used in chemical analysis, but apparently their application to the decomposition of minerals for purposes of determination of the latter has been overlooked. Dr. Bolton, after a few preliminary trials, having satisfied himself that

all preconceived notions as to the weakness of organic acids with respect to minerals was erroneous, began a series of investigations; the results of these were embodied in a paper read before the New York Academy of Sciences, and have been published in a recently distributed number of the Society's "Annals."

Inasmuch as the hardness, solubility and other characters of minerals vary greatly in different specimens of the same species, it would have been a very laborious as well as unnecessary proceeding to have tested the reaction of a number of specimens of each mineral, because the decomposing action of the acids on different samples of the same species differs in degree, not in kind; and the behavior of different, nearly related species is so very similar that experiments made on each serve to mutually control. The minerals that were submitted to the action of the organic acids in these investigations were embraced within the groups, (1) Carbonates, (2) Sulphides, (3) Oxides, (4) Metals and (5) Silicates. The organic acids employed were chiefly citric, tartaric and oxalic. A few tests were made also with malic, formic, acetic, benzoic, pyrogallic and picric acids. The solid acids were used in the form of cold saturated solutions; the liquid acids were the ordinary commercial products.

The method of procedure was very simple, and as follows: The mineral to be examined was carefully freed from associated minerals, pulverized finely in an agate mortar, and a portion placed in a test-tube; the acid solution was then added, and the results, in the cold and on boiling, carefully noted. The reactions observed were briefly as follows:

(1) *Carbonates.*—The natural carbonates dissolve with effervescence more or less readily in dilute and strong cold and hot solutions of citric, tartaric, oxalic, malic, formic, benzoic, acetic, pyrogallic and picric acids; the relative power of the acids being in the order named. It should be stated here that the author in making his experiments kept constantly in view the possible employment of the methods in the field, and therefore conducted his tests in the simplest manner. Citric acid was found to effect the decomposition of the mineral carbonates with such ease as to render it extremely useful where hydrochloric acid cannot be conveniently employed. The organic acid acts, however, much slower, and on some minerals it has at first no effect. The time of incipient action also varies with the acid used. Porous minerals, and those with highly polished surfaces, appear to resist the action of the acids. In the latter case the action may be rendered visible by scratching the surface with a knife and applying the acid solution to the roughened surface. In earthy minerals the acid should be applied repeatedly at the same point until, the pores being filled, the action on the surface becomes apparent. With tartaric acid, the mineral carbonates behave much in the same way as with citric, and the same may be said of oxalic acid. Acetic acid does not act so energetically on the mineral carbonates as do the preceding. Formic acts more powerfully than acetic, and malic acid acts quite energetically, but its high price in a state of purity, and the difficulty of obtaining it thus, precludes its use.

(2) *Sulphides.*—The tests were made as follows: The pulverized minerals were placed in test-tubes, a concentrated solution of citric acid added, and a piece of paper moistened with plumbic acetate suspended in each tube, which was then corked. After standing twelve hours the blackened test-papers gave evidence of the decomposition. On heating, the disengagement of sulphureted hydrogen was very marked. Tartaric and oxalic acids act in a similar manner, both in the cold and on boiling. The *liquid* acids (acetic, etc.) are powerless to effect decomposition. Although the action of organic acids on mineral sulphides is not so decided as that of mineral acids, this is no disadvantage; but, on the contrary, affords additional means of determination, For it will be found that some minerals (like bornite, etc.) are decomposed by citric acid, while their kindred compounds are not. It is evident then that the organic acid may be used to distinguish two allied minerals one from the other.

(3) *Oxides.*—A few of the mineral oxides examined are attacked by the organic acids in the cold. The minerals are apparently more quickly and completely dissolved by oxalic than by citric acid. The oxides behave with tartaric acid in all respects as with citric.

(4) *Metals.*—It is a well-known fact, stated in many handbooks of chemistry, that citric and tartaric acids dissolve iron and zinc with evolution of hydrogen gas. In repeating and extending these observations the following facts were noted: Iron, zinc and magnesium dissolve readily in cold saturated solutions of citric, tartaric, oxalic, malic and formic acids, evolving hydrogen more or less freely; on heating the action becomes violent. A cold saturated solution of citric acid diluted with half its volume of water attacks zinc slowly in the cold; on boiling, hydrogen comes off freely and continues so to do for a long time after cooling. Tartaric acid acts on zinc feebly in the cold; on boiling, solution ensues, and the liquid becomes milky from the formation of insoluble tartrate of zinc. A cold concentrated solution of oxalic acid attacks zinc immediately; but the action soon ceases on account of the surface of the zinc becoming coated with an insoluble zinc oxalate. On heating to boiling, the action is resumed, but soon again ceases from the same cause as before.

(5) *Silicates.*—It was found that those silicates which are decomposed by hydrochloric acid, either with or without the formation of a jelly, are attacked more or less strongly by a hot solution of citric acid.

Out of twenty-four minerals examined, fourteen were decomposed readily either with or without the production of gelatinous silica; five were attacked with difficulty, and five resisted the acid.

Wishing to extend the use of organic acids in attacking minerals, the effect was tried of adding oxidizing agents to the solution of acid. It was found that when the nitrates of potassium, sodium or ammonium were added to a boiling solution of citric acid, nitric acid was set free at a certain degree of concentration of the solution, and attacking the organic acid decomposed it with the evolution of gases. The nitrite of potassium was found to decompose citric acid in a similar way with the production of nitric acid, which being in a nascent condition is prepared to effect oxidation in a most powerful manner. Tartaric and oxalic acids were found to act like citric. Acetic and formic acids decompose neither the nitrates nor nitrites.

By means of these interesting reactions the author was enabled to attack many mineral sulphides with the greatest ease; but upon applying the same method to several other classes of minerals, it was found to possess little advantage. The mixture of nitrate of potassium and citric acid is a powerful solvent of metallic copper, silver, lead, tin, bismuth, antimony, magnesium, iron and zinc, but aluminum resists it. As a summary of the results of his investigations, Dr. Bolton states that he has established the hitherto unrecorded fact that organic acids not only decompose a considerable number of minerals belonging to various groups, but that they possess, moreover, a remarkable selective power as regards the degree of this decomposition; and as an example of the latter he cites citric acid, which alone divides minerals into eight groups.

The application of the methods of examining minerals as detailed in this paper are, as the author well remarks, numerous and important. One of the most useful, perhaps, will be for the purposes which suggested these investigations—the determination of minerals in the field. The reagents recommend themselves at once on account of their portableness, and the readiness with which they may be applied, and the characteristic and sensitive nature of their reaction. They may be used not only to determine specimens, but also to distinguish minerals that are nearly related to one another, and probably also to separate minerals mingled in one mass. For field use, in mineralogical investigations, Dr. Bolton proposes (as a substitute for the array of mineral acids hitherto carried by the geologist and mineralogist during his excursion) a stout pasteboard box, containing solid citric (or tartaric) acid, for the usual glass bottle of hydrochloric acid, and the addition of nitrite of potassium to the usual list of dry reagents contained in portable blowpipe cases. Since solution of citric acid decomposes nitrite of potassium in the cold, nitric acid can be carried thus practically in a solid form; hydropotassium sulphate, already in use, furnishes sulphuric acid in a solid state, and it only remains then to provide for hydrochloric acid. Thus far experiments have failed to solve this problem; chlorides of ammonium, sodium and potassium appear to resist the action of organic acids. On the other hand, iodine, less powerful than chlorine, possesses similar properties, and will form a valuable addition to the list of dry reagents.

Citric acid, nitrite of potassium, and iodine, then, added to the reagents in common use—borax, carbonate of sodium, cyanide of potassium, ammonio-sodium phosphate, test lead, tin—and an assortment of test papers (including acetate of lead paper), together with as many of the solid reagents used in solution as space will permit, would complete the outfit of *dry reagents* for *wet analysis* and for blow-piping.

The author believes that this newly discovered power of the organic acids has an important bearing on the chemistry of geological changes, and that organic acids resulting from the decomposition of vegetable and animal matters demand recognition as powerful agents in the work of disintegration and consolidation. That they do assist in the disintegration of rock material seems evident from the existence in the soil of the ulmates, humates, apocrenates and crenates of potash, soda, ammonia, lime, manganese, iron and alumina.

CRUDE ANTHRACENE.

By Dr. Othmar Zeidler.

In experimenting with a supposed pure material the author obtained results indicating that in addition to the well-known and more plentiful compounds, other substances were present which adhere obstinately to anthracene. In order to separate these compounds he had recourse to the action of solvents and fractionated crystallization. The procedure adopted was a twice repeated extraction of the anthracene with water acidulated with sulphuric acid, in order to remove acridin. The residue was dried, extracted at an ordinary temperature with five-fourths of its weight of acetic ether, pressed, digested again with the same quantity of acetic ether, and the residue after pressure was washed upon the Bunsen pump with the same quantity of the solvent till the liquid running off was merely slightly yellow. Of the original 400 grms. 235 were dissolved. The acetic ether was then distilled off, and the residual brown cake submitted to distillation. The portion insoluble in acetic ether consists essentially of anthracene, along with chrysen and other bodies, and it has as yet not been submitted to further examination. The portion dissolved in acetic ether was next treated as follows: It was extracted with warm alcohol at 40°, let cool, and filtered (filtrate No. 1). The residue was treated in a similar manner with benzol (filtrate No. 2). The residue was treated with a minimum of hot benzol and filtered without cooling (filtrate No. 3), while the residue upon the filter was marked No. 4. No. 1 contains carbazol, phenanthren, fluoren; No. 2 contains synanthren; No. 3 anthracene and pseudophenanthren, while the portion insoluble in benzol consists of carbazol. From the latter the author obtained a new derivative, nitroso-carbazol, which dissolves in sulphuric acid with a dark green color, which, on the application of heat (100°), becomes a blue-green, while nitrous acid escapes. On the addition of water a dark green precipitate falls, partially soluble in water with a green color, the solution turning to a dirty violet in presence of an alkali.

Absorptive Power of Soils.—By Dr. W. Pillitz.—The quantities of potash and ammonia which are capable of being absorbed by the same quantity of the same soil are in proportion to the equivalents of these compounds. When earth saturated with sal-ammoniac was treated with solution of phosphate of potash, the absorption of the potash was effected, but not of the phosphoric acid.

Disengagement of Oxygen from Green Twigs Submerged in Water Previously Boiled and Exposed to the Sun.—By Prof. Jos. Böhm—If fresh green shoots of *Ligustrum vulgare* are exposed to the sunlight under water previously boiled, they evolve much more oxygen than corresponds to the quantity of air contained in them before the experiment. This oxygen is chiefly derived from the carbonic acid thrown off from the substance of the twigs in consequence of internal respiration. On prolongation of the experiment, the development of gas becomes slower and slower, and ceases entirely in three or four days, although the shoots still appear fresh and healthy. If the same twigs are again exposed to the light in a fresh portion of boiled water, they merely give off at first a few bubbles of gas, and if the experiments are continued above a week, the green rind turns brown, and carbonic acid and hydrogen are evolved in consequence of butyric fermentation.

Ripening Process of Grapes.—By E. Mach, Fr. Kurmann and A. Schultz.—Mach concludes that the weight and diameter of grapes increase at first rapidly, till the time for the change of color is near, after which the increase becomes slow. The absolute percentage of sugar increases at first slowly, but becomes rapid when the coloration begins. The quantity of free acid increases at first, but from the moment of incipient coloration it decreases, both relatively and absolutely. Tannin is relatively most abundant at first, and disappears almost entirely at the time of coloration. Starch disappears on ripeness.

REFRACTION OF GASEOUS BODIES.

By M. Mascart.

The refraction of a gaseous mixture is equal to the sum of the refractions of the constituent gases, each of them being reduced to the total volume of the mixture, but this law is inexact for compound bodies, the real refraction of which is generally less than what the calculation would indicate. Four substances alone seem exceptional, the protoxide and binoxide of nitrogen, hyponitric acid, and ammonia. The three former are endothermic, that is to say they cannot be obtained without absorption of heat, while ammonia is formed with liberation of heat. The cause of this increase of refraction, therefore, does not seem to depend on the sign of the thermic phenomena accompanying combination. Further hydriodic acid is also endothermic, yet the refraction of the gas follows the general rule. It appears that no method founded upon the sole consideration of elementary composition permits us to calculate the refraction of a compound from that of its elements.

DISSOCIATION OF SULPHIDES IN PRESENCE OF BOILING WATER, AS WELL AS AT TEMPERATURES BELOW 100°.

By MM. de Clermont and de Frommel.

The authors find that certain hydrated sulphides on boiling are dissociated into hydric sulphide on one hand and oxide on the other. This phenomenon has been observed in case of most sulphides, with the exception of those of copper, bismuth, and mercury. They have not been able to draw out the general law of this reaction, the transformations of the sulphides in presence of water being very complex. Arsenic trisulphide is dissociated on boiling into hydric sulphide, which escapes, and arsenious acid, which remains in solution. This fact has led them to a new process for the separation of arsenic in presence of other metals, especially tin, antimony, gold, platinum, and all the other metals whose sulphides are decomposable by boiling water. They proceed as follows:—The mixed sulphides are suspended in water, and raised to a boil. The arsenic sulphide is rapidly dissociated, ebullition for twenty to twenty-five minutes being for 5 to 6 centigrms. of sulphide. All the sulphides except that of arsenic yield insoluble oxides which may be removed by filtration from the soluble arsenious acid, which may then be determined by ordinary methods. The same process is applicable to the separation of arsenic acid.

ANALYSIS OF TIN CRYSTALS.

Goppelsroeder and Trechsel add the tin salt in hot solution to a known weight of chromate of potash, which oxidizes it to the state of perchloride of tin. They decompose the excess of chromate with muriatic acid, pass the chlorine evolved into a solution of the iodide of potassium, and titrate the iodine set at liberty with the hyposulphite of soda. Or they dissolve the tin salt in muriatic acid after the addition of a known weight of chromate; when the reaction is at an end, they add an excess of the iodide of potassium and titrate with hyposulphite of soda after the lapse of five minutes.—*Zeitschrift für Analytische Chemie.*

The hygroscopic property of cobalt chloride is utilized in a style of handkerchiefs now sold as "Foulards baromètres." The design is a man carrying an umbrella, the latter being printed in chloride of cobalt. If the weather is fine and dry the umbrella appears blue, but turns gray on unsettled days, and becomes white in rain. The first washing removes the color.

Malachite green is a new dye, discovered by Dr. Oscar Döbner, and formed by the action of benzotrichloride upon methyl-aniline in presence of metallic salts. The color in question is the only product of the reaction. It is calculated to be a very formidable rival to methyl-green, as it does not, like the latter, change its color on the application of a boiling heat.

Sulphureted Oils Possessing Insecticide Properties.—MM. de la Loyere and Muntz.—The oils in question are obtained by the distillation of the bituminous limestone of Orbagnoux, near Seyssel. They have been successfully used against the phylloxera.

Regeneration of Spoiled Albumen.—Albumen which has become partially insoluble may be restored if heated to 95°—104° Fahr. in water containing 2½ per cent. of hydrochloric acid and 7½ of the stomachs of calves cut up into shreds, the pepsine being the active principle. The solution is filtered after the lapse of 36 hours, and neutralized with ammonia. M. Witz uses for the same purpose the stomachs of sheep in an acid solution, keeping up a heat of 104° Fahr. for 40 hours.

A patent has recently been taken out in Germany by MM. Bahse and Haendel for making sieve-hoops and like objects by a dry process from cut wood. Two rollers are used, one above the other and having less velocity, so that it acts by holding back, while the lower extends the wood fibers. When the board, thus bent, leaves the rollers, it is fastened in the mouth of the sieve. The upper roller is fluted, the under one smooth. If two smooth rollers were used a very much greater pressure would be necessary.

Improvement in the Determination of Potash in Chloride of Potassium and in Kainite.—The determination of potash by means of the chloride of platinum is less to be depended upon when the mere impurities, such as common salt, are present. The amount of potash is then generally estimated too high, because the double chloride of platinum and sodium, when it has once become dry, can no longer be readily washed out by means of alcohol. To remove this source of error, Ulex adds a little glycerine, which prevents the saline solution from drying up, and very much facilitates the washing of the platino-chloride of potassium. —*Zeitschrift fur Anal. Chemie*, XVII., 175.

Kathreiner has published in *Dingler's Journal* an examination of the various methods proposed for the analysis of wares containing tannin. He finds that Carpené's method (boiling the decoction with an excess of ammoniacal acetate of zinc, concentrating down to ⅘, filtering when cold, dissolving the precipitate in dilute sulphuric acid, and titrating the filtered solution with permanganate) is not merely very tedious, but quite inaccurate.